

10/035350
152
86
FTB

10035350 " 102601

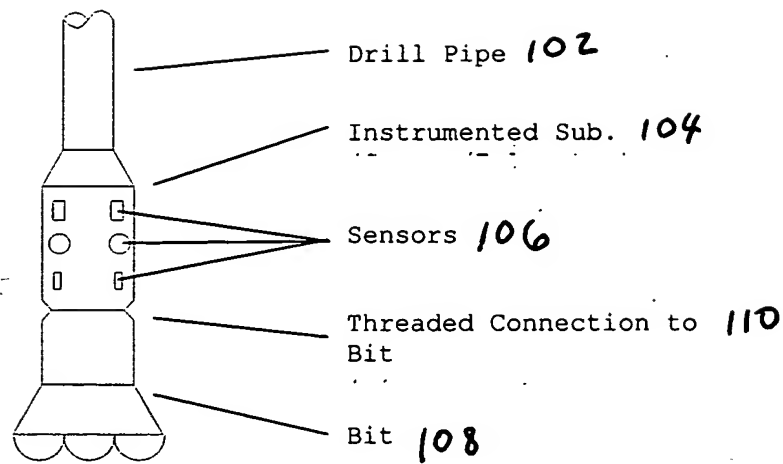


Figure 1. Sensor Placement Relative To Bit

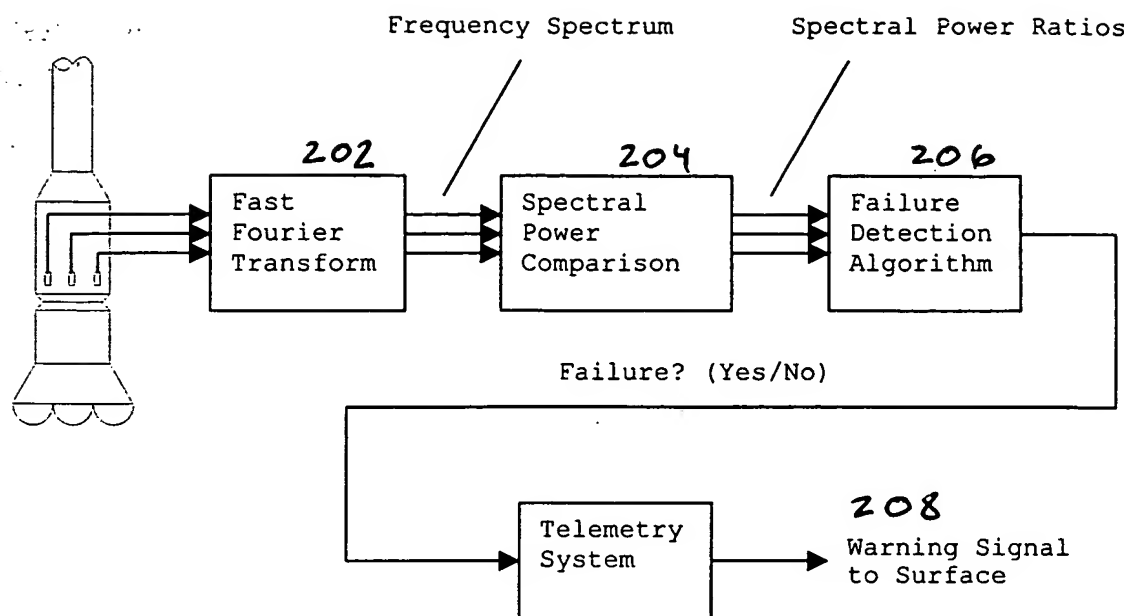


Figure 2

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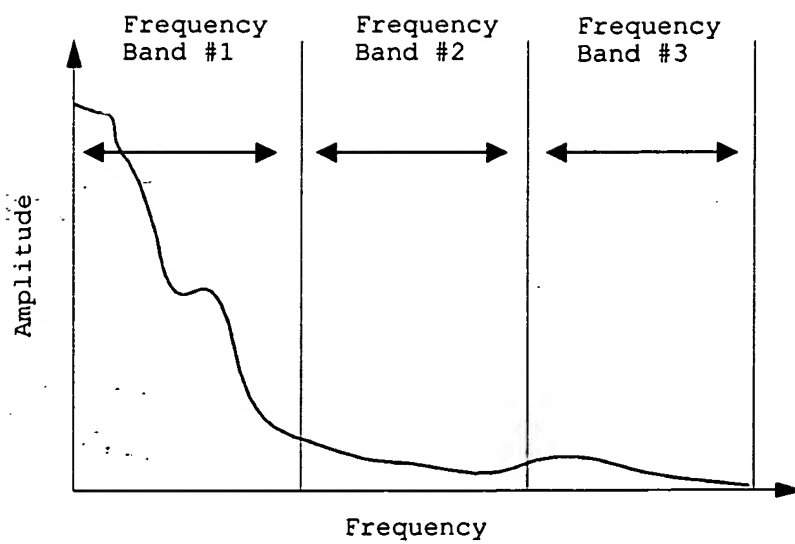


Figure 3. Frequency Band Arrangement

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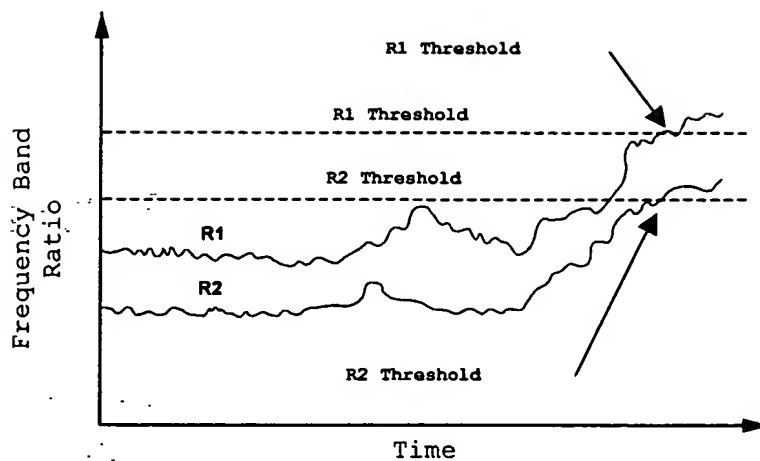


Figure 4. Threshold Failure Detection

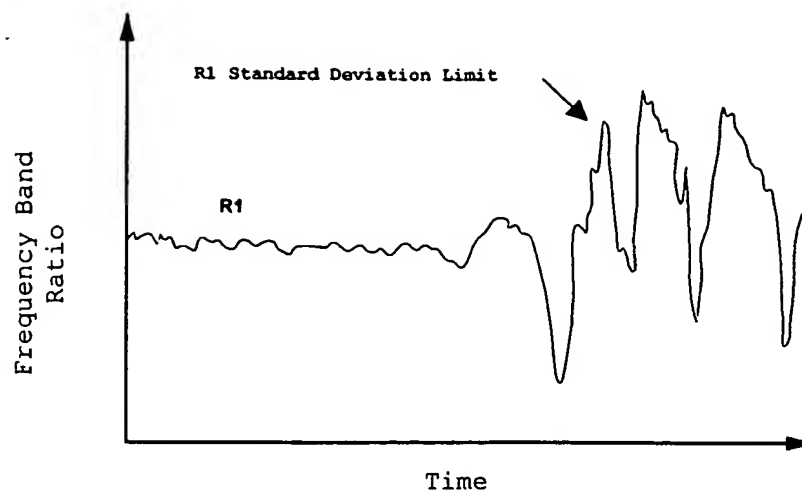


Figure 5 Statistical Failure Detection

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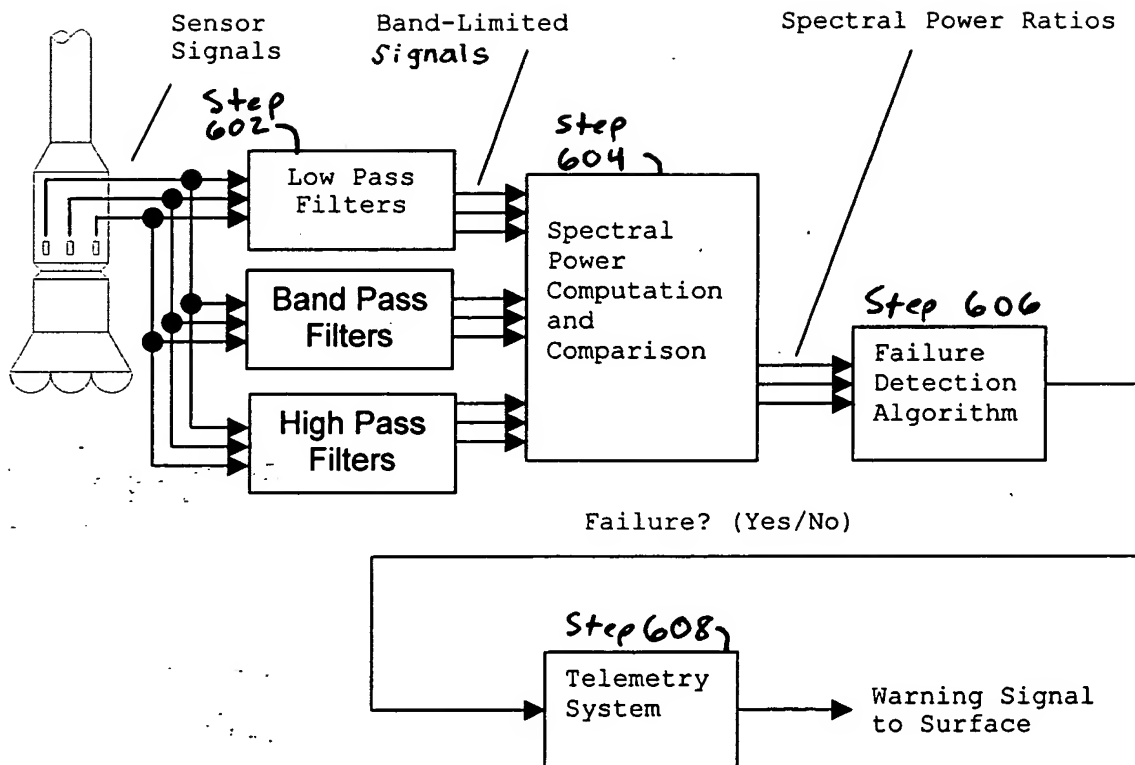


Figure 6 SPRA Method Using Analog Filters Spectral Power Separation

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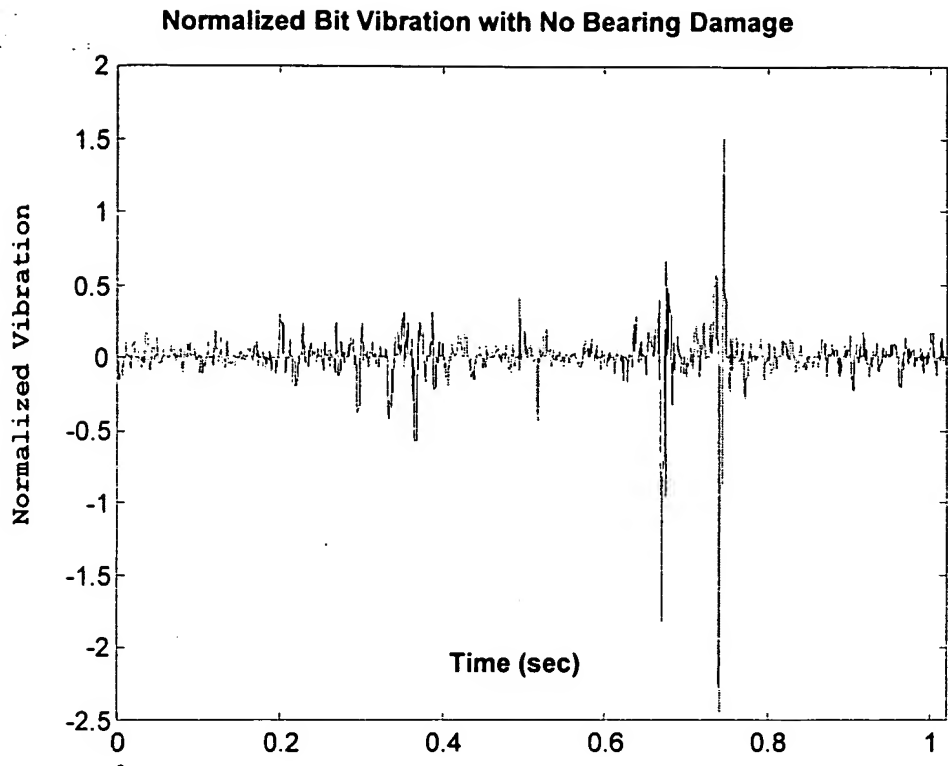


Figure 7.

Discrete FT of Vibration Data with No Bearing Damage

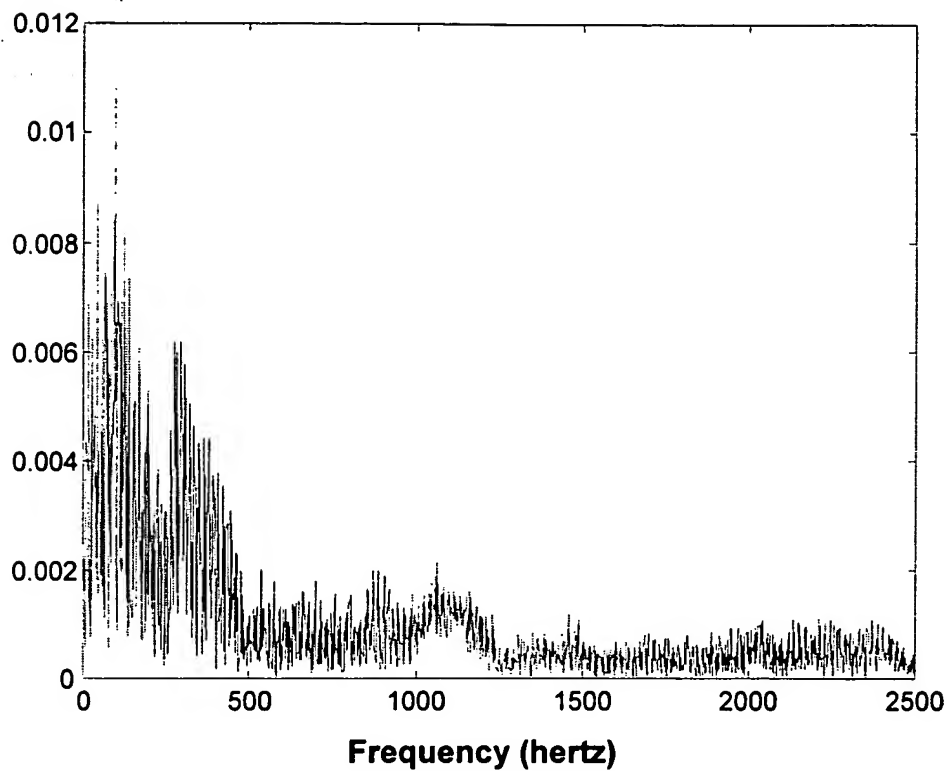


Figure 8.

10035350-102601

Spectral Power Analysis Bearing with Noise

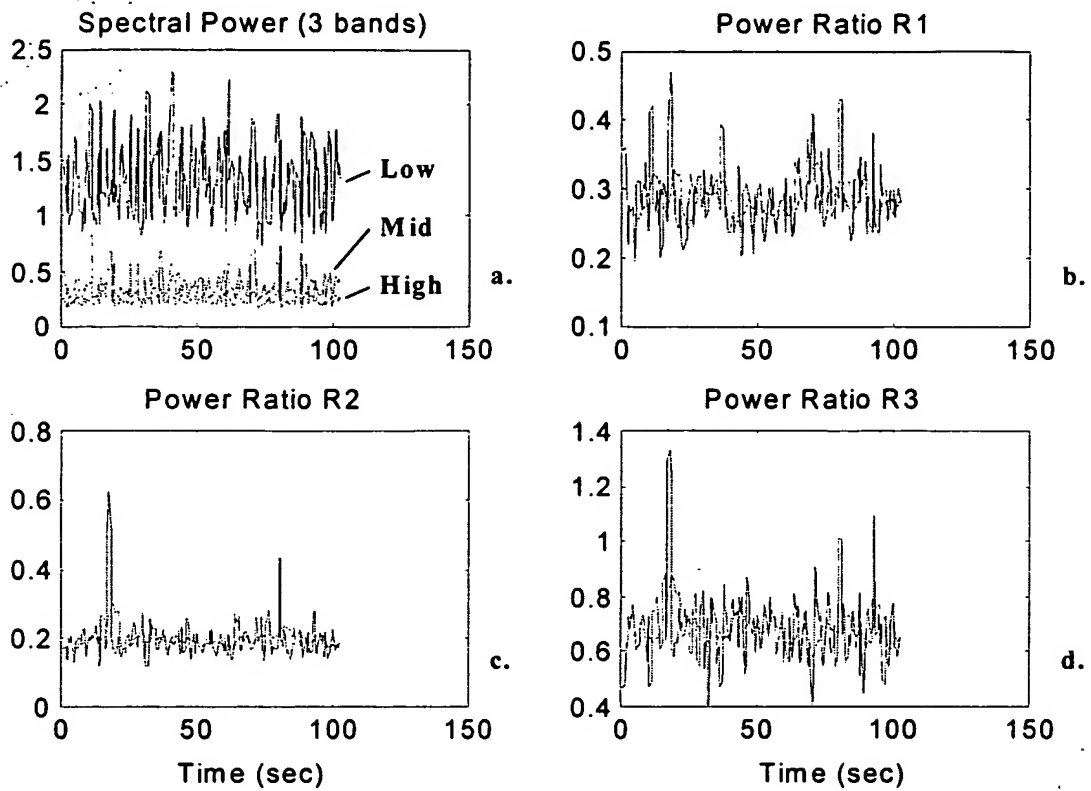


Figure 9.

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10920T 05500T

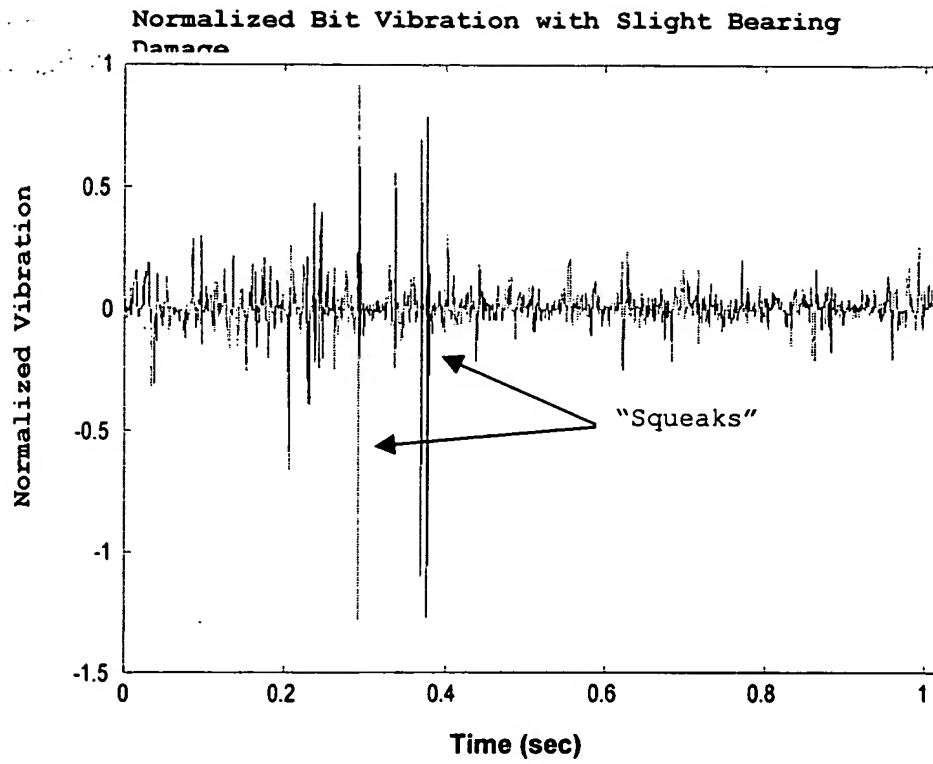


Figure 10.

Discrete FFT of Vibration Data with Initial Bearing Damage

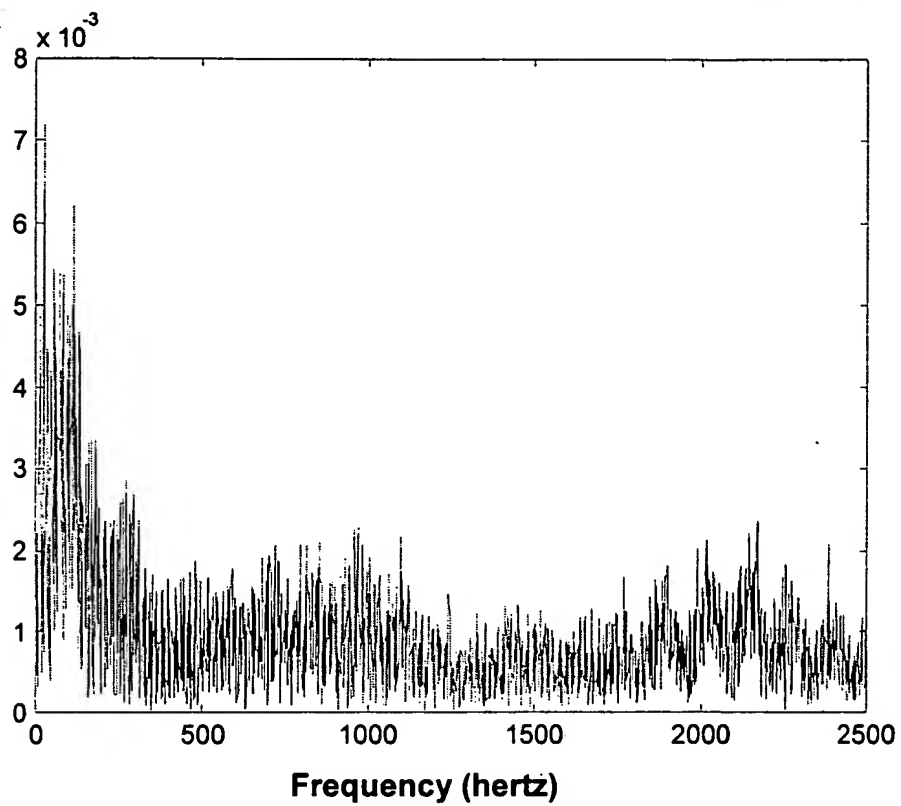


Figure 11.

10035350-10601
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Spectral Power Analysis for Slightly Damaged Bearing

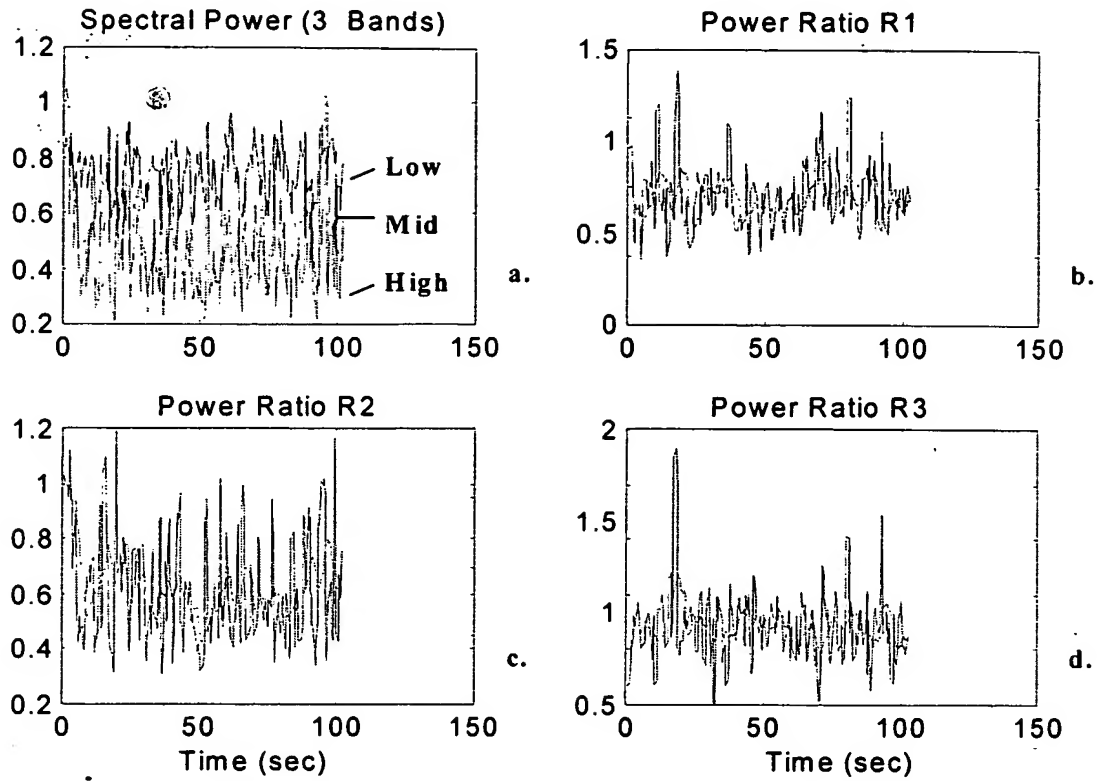


Figure 12.

Normalized Bit Vibration with Moderate Bearing Damage

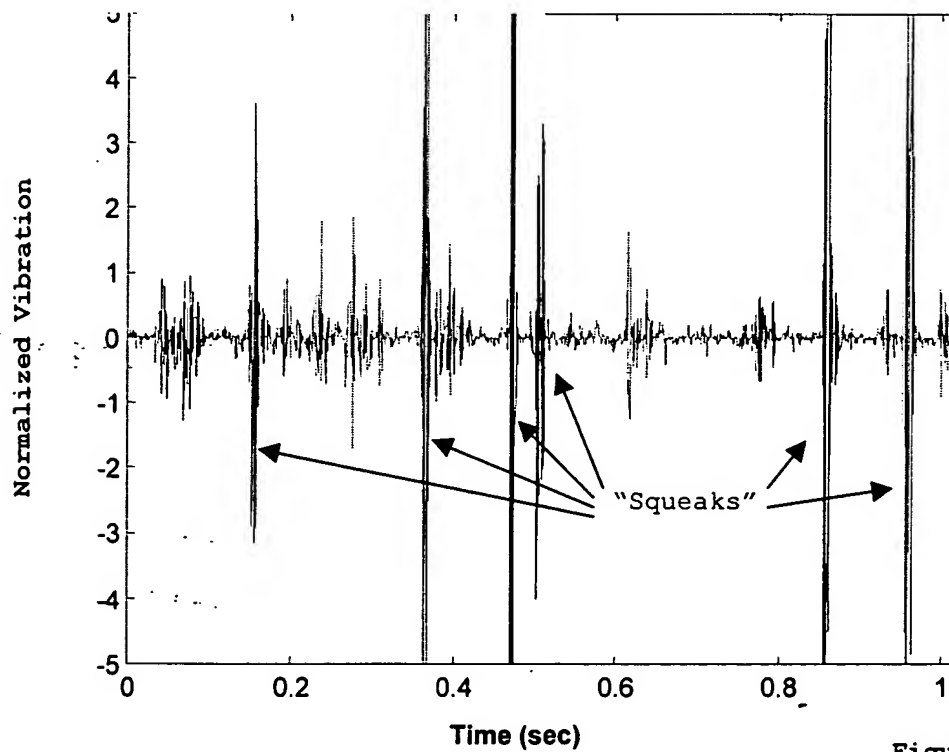


Figure 13.

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Discrete T of Vibration Data for Moderate Bearing Damage

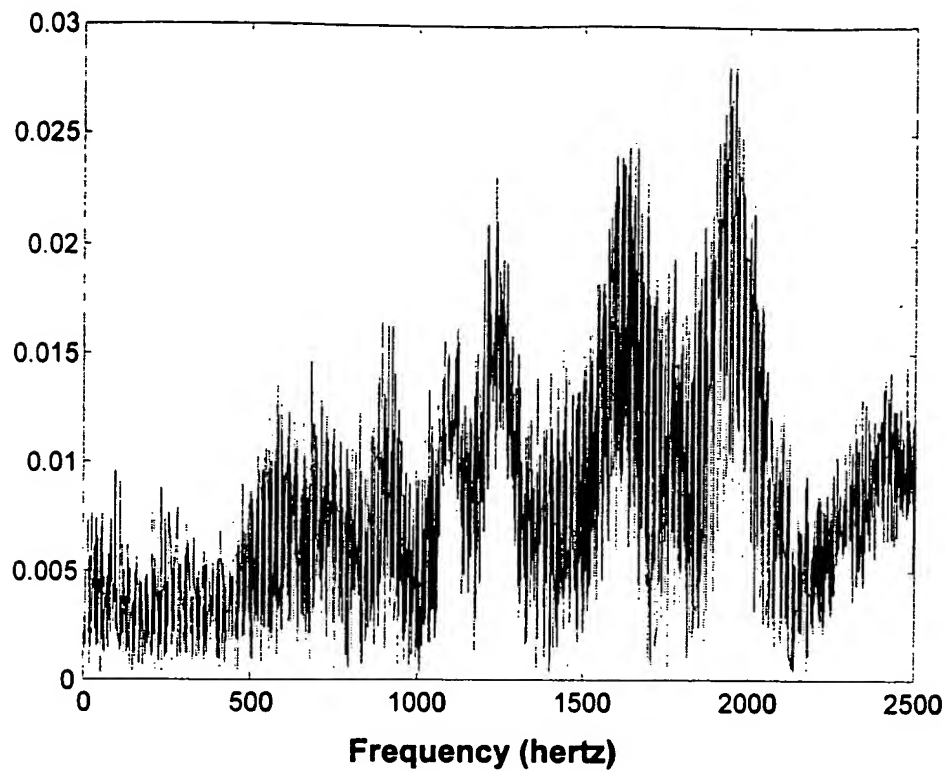


Figure 14.

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1003330-10601

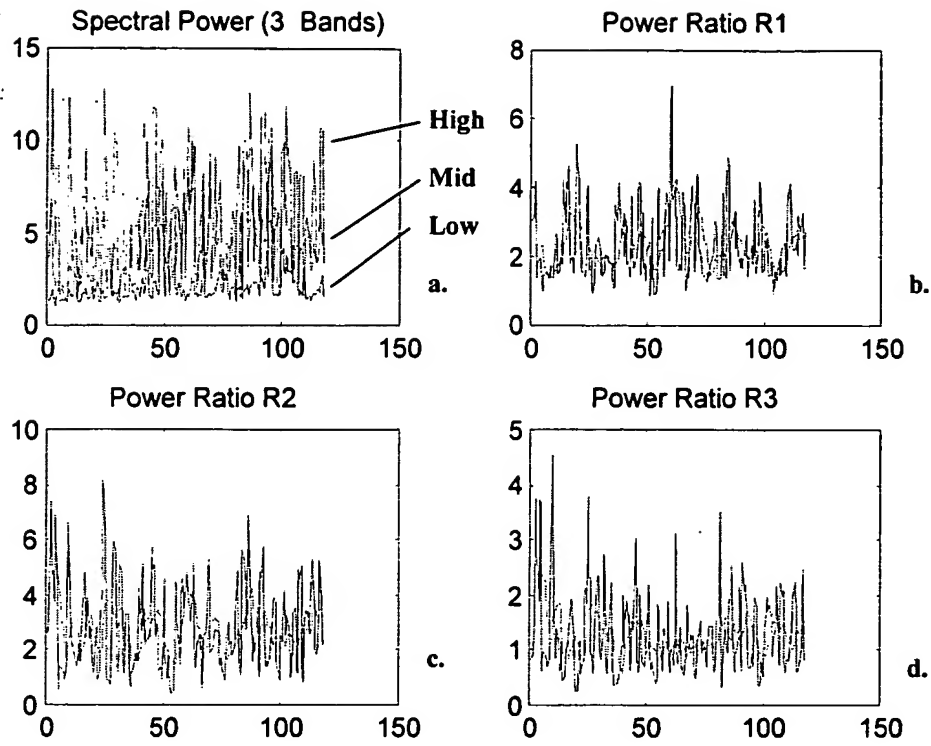


Figure 15.

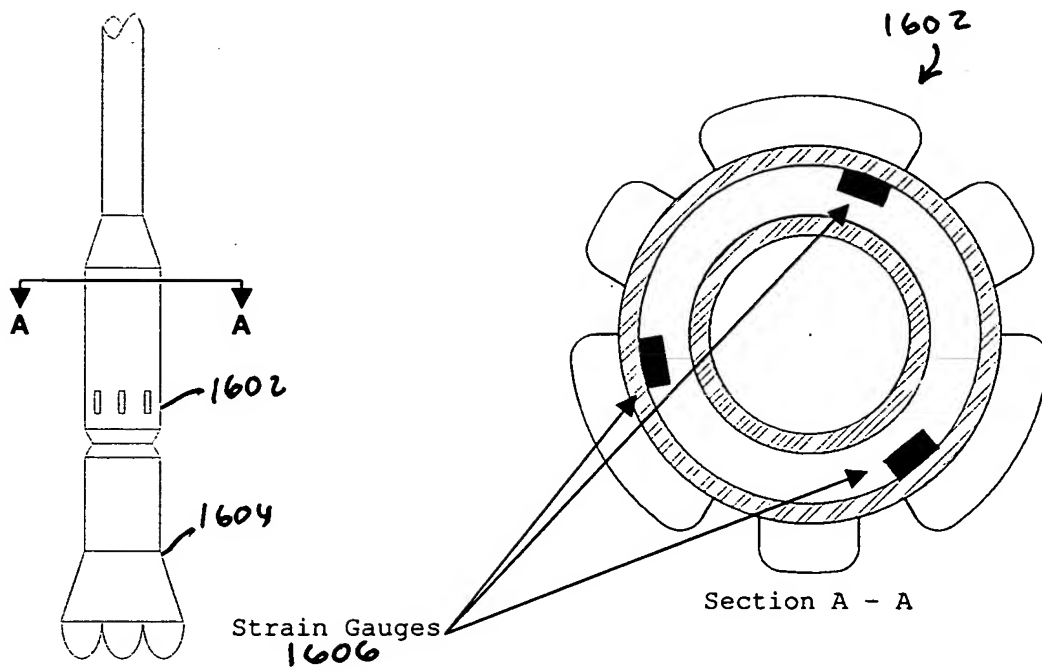


Figure 16. Strain Gauge Placement In Sensor Housing

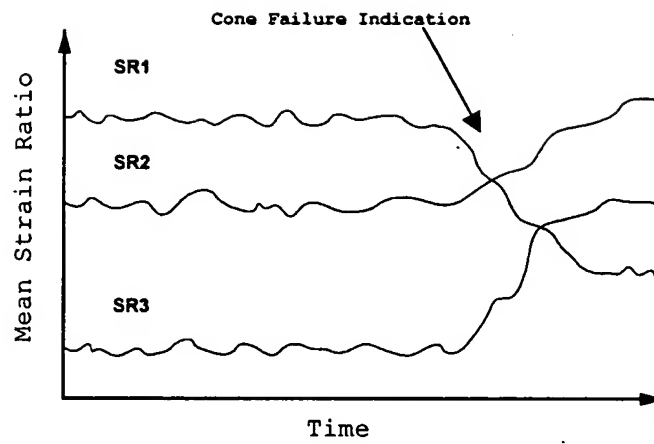


Figure 17. Failure Indication (MSRA Method)

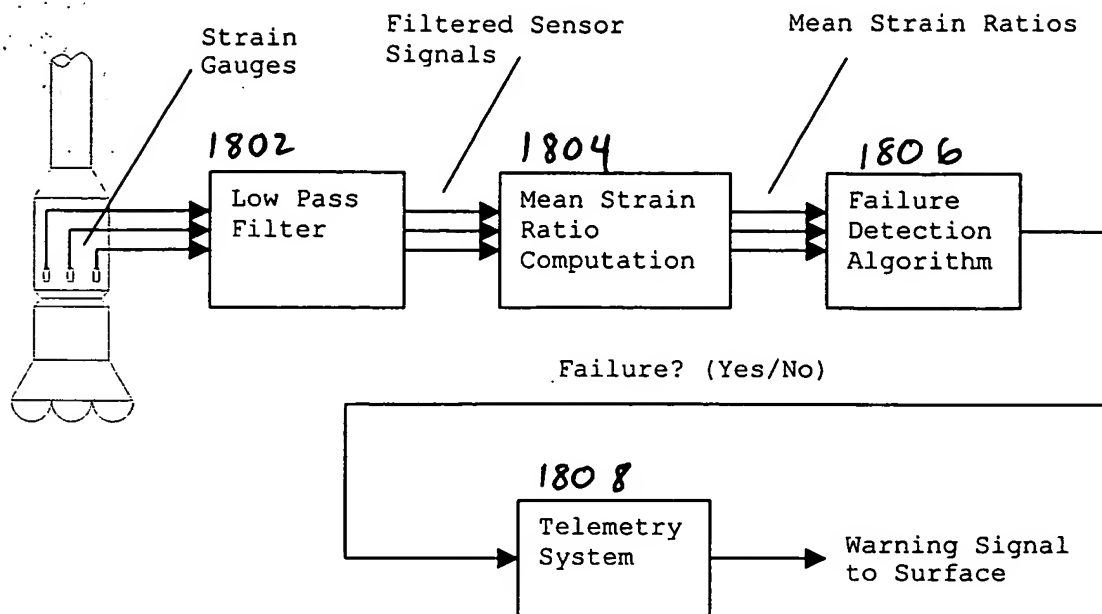


Figure 18. Schematic of MSRA Failure Detection Scheme

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Strain Gauge for No Bearing Damage

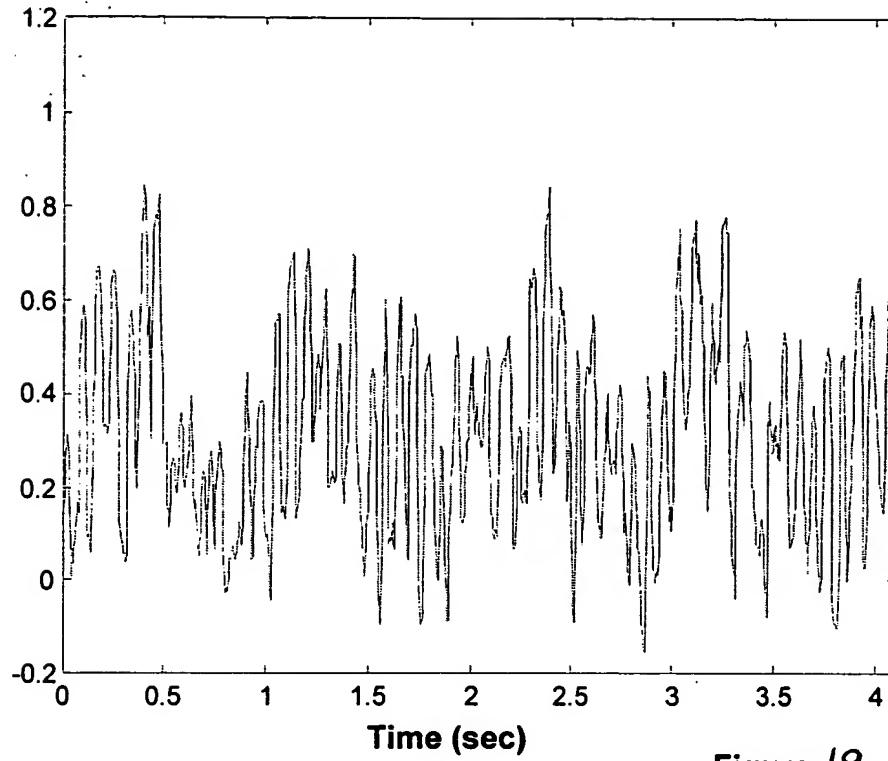


Figure 19

Discrete FFT of Strain Gauge Signal for No Bearing Damage

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Discrete FFT of Strain Gauge Signal for No Bearing Damage

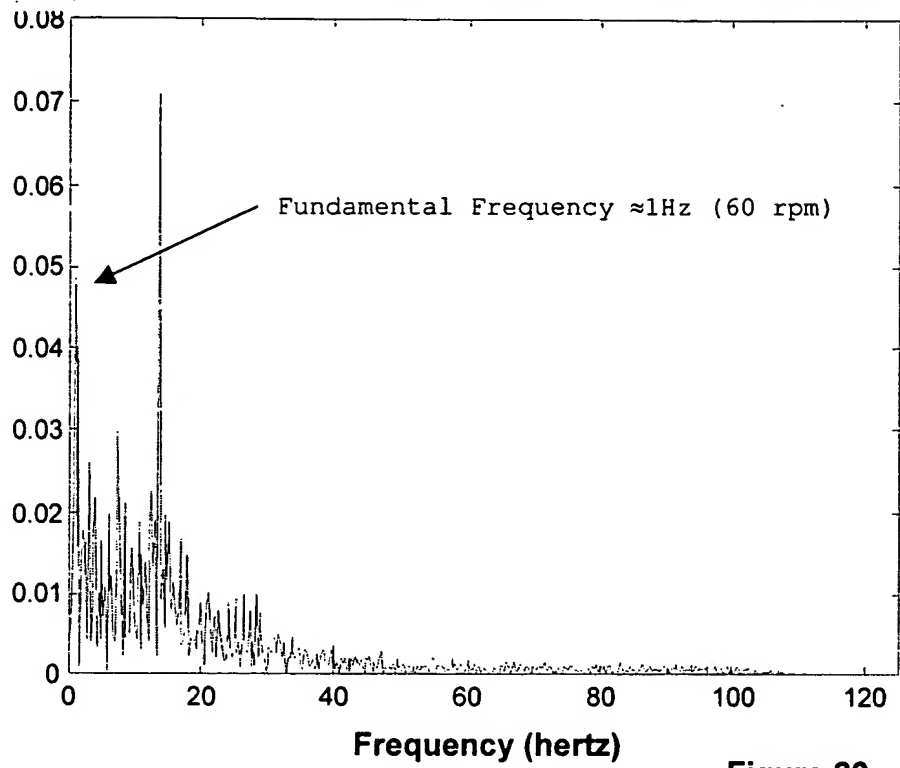


Figure 20.

Mean Strain Analysis for Bearing with No Damage

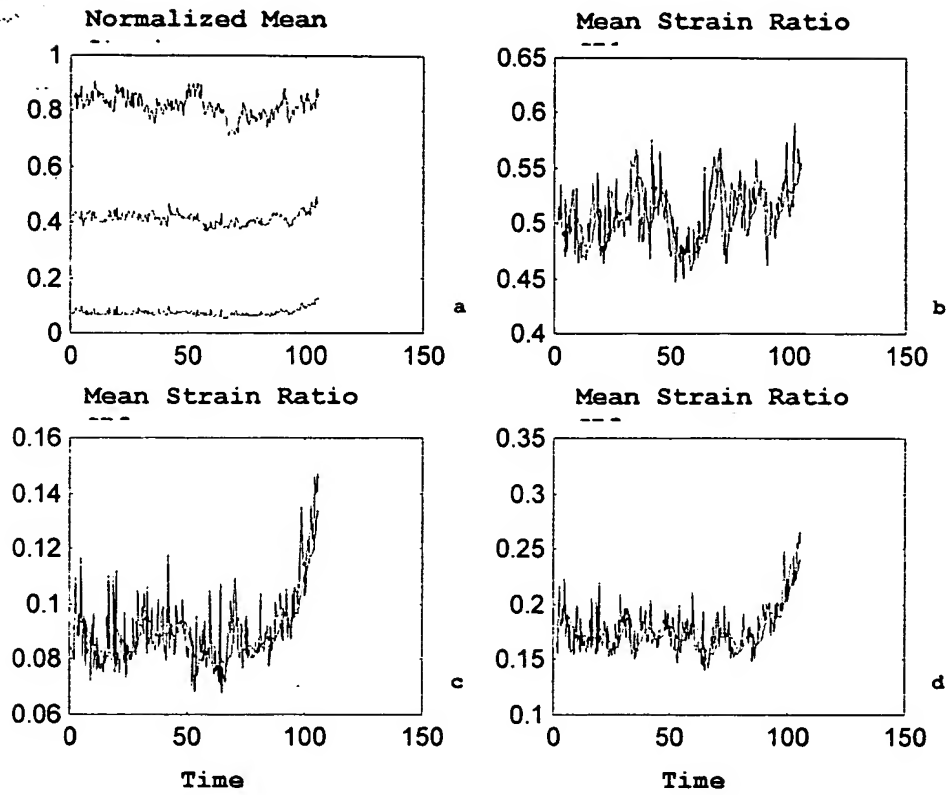


Figure 21.

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Strain Gauge Signal when Bearing Lightly Damaged

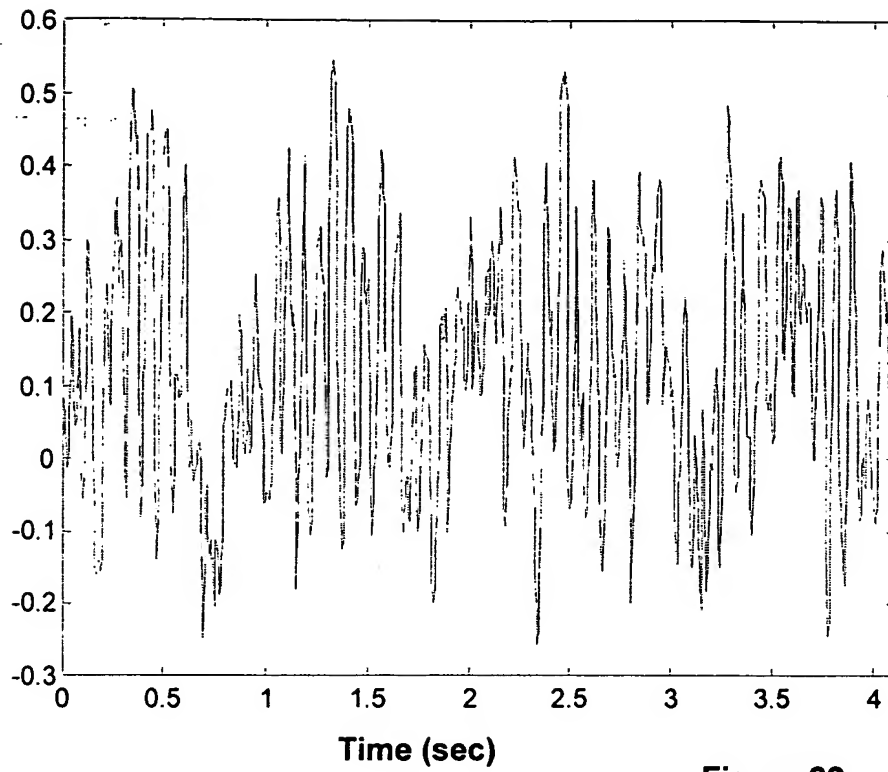


Figure 22.

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Discrete FFT of Strain Gauge Signal for Light Bearing Damage

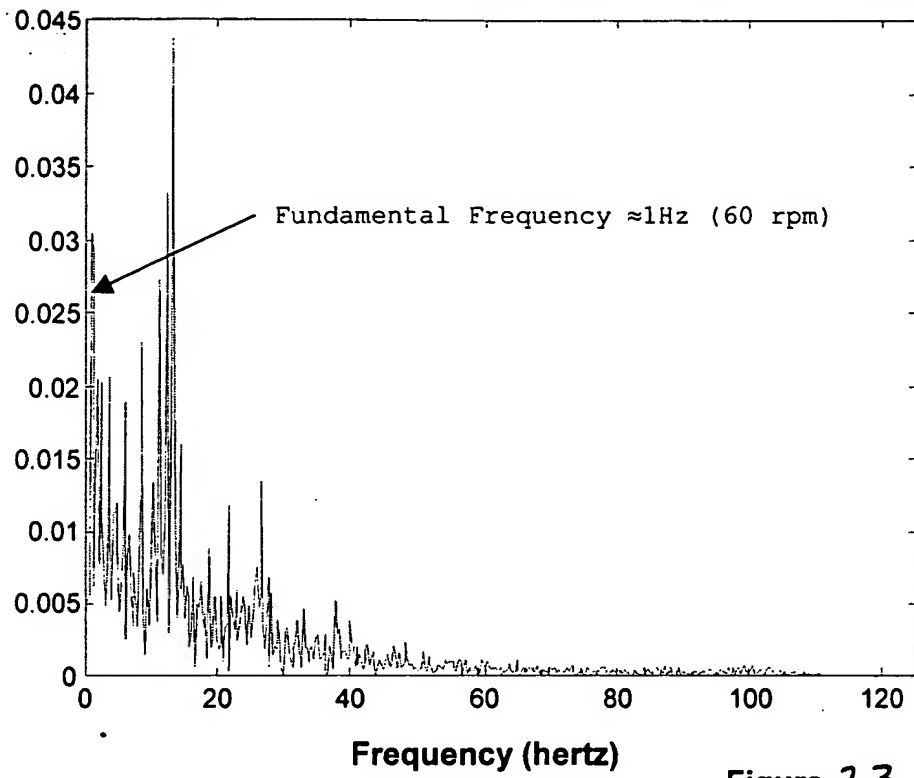


Figure 23

10035350-102601

Mean Strain Analysis for Bearing with Line Damage

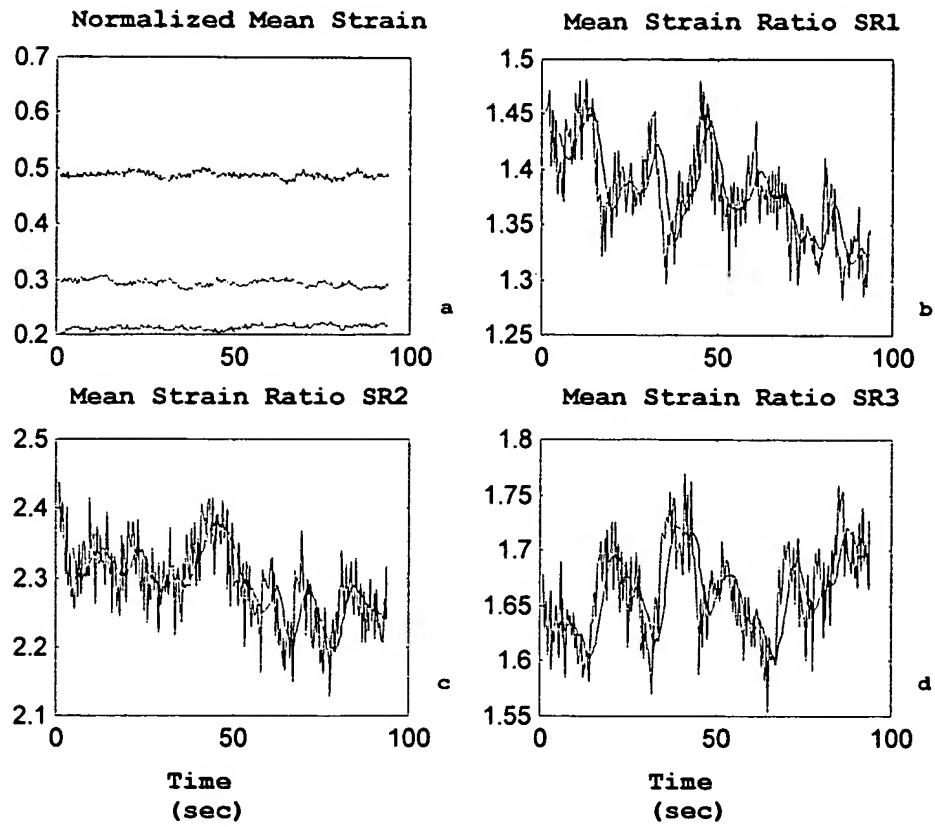


Figure 24

1003550-105001

Strain Gauge Signal when Bearing Moderately Damaged

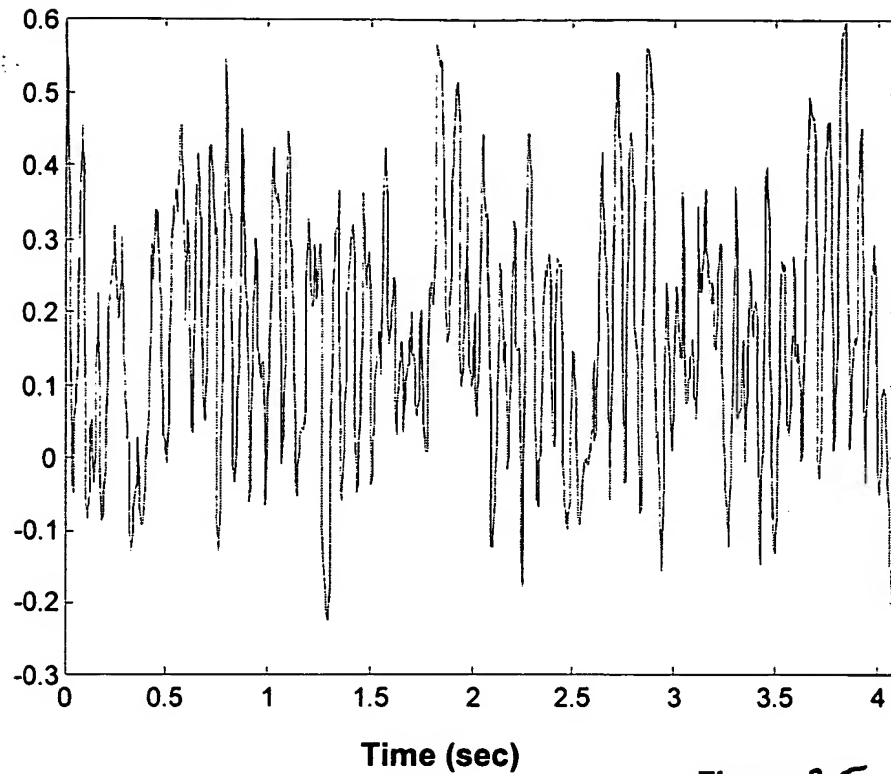


Figure 25

Discrete FFT of Strain Gauge Signal for Moderate Bearing Damage

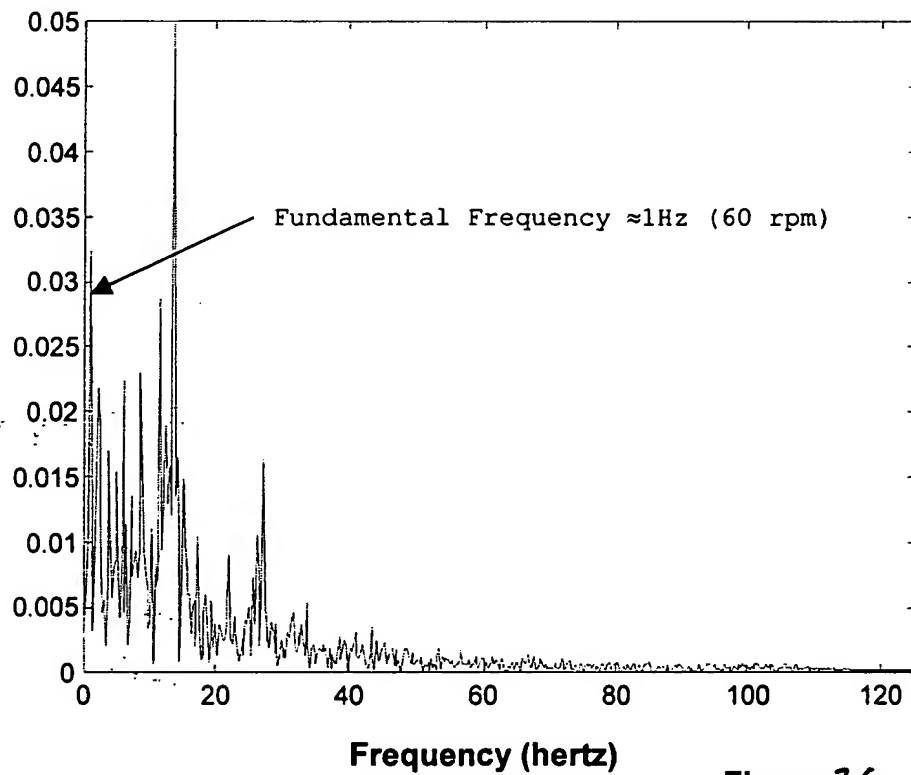


Figure 26

10035350-105001

Mean Strain Analysis for Bearing with Moderate Damage

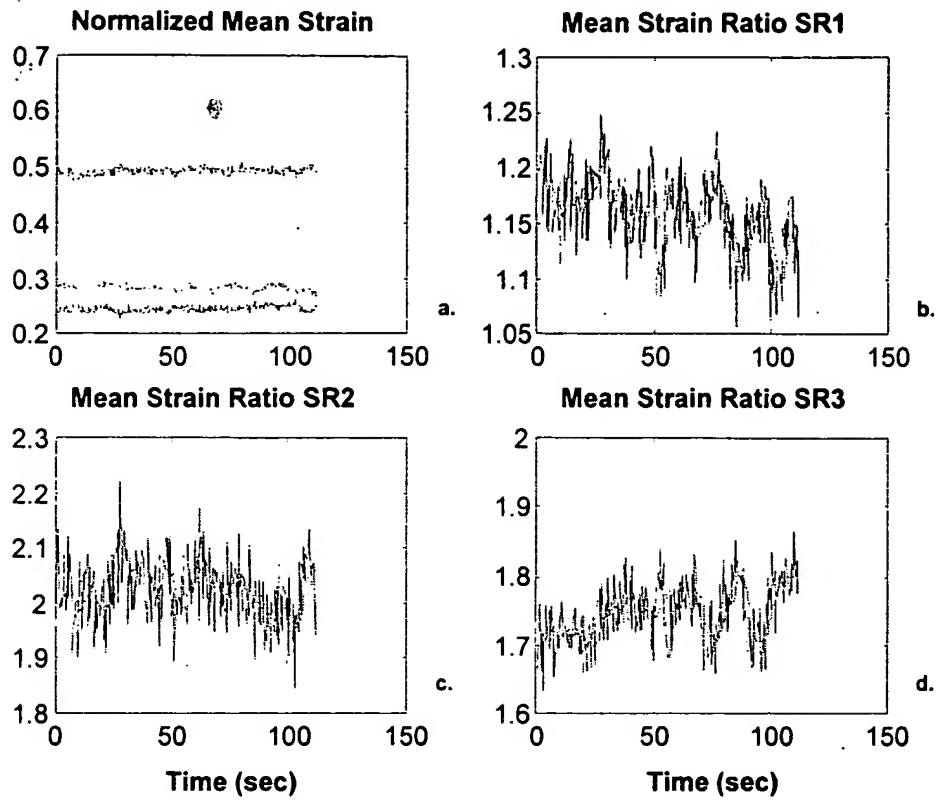


Figure 2.7

Strain Gauge Signal with Bearing In Early Failure

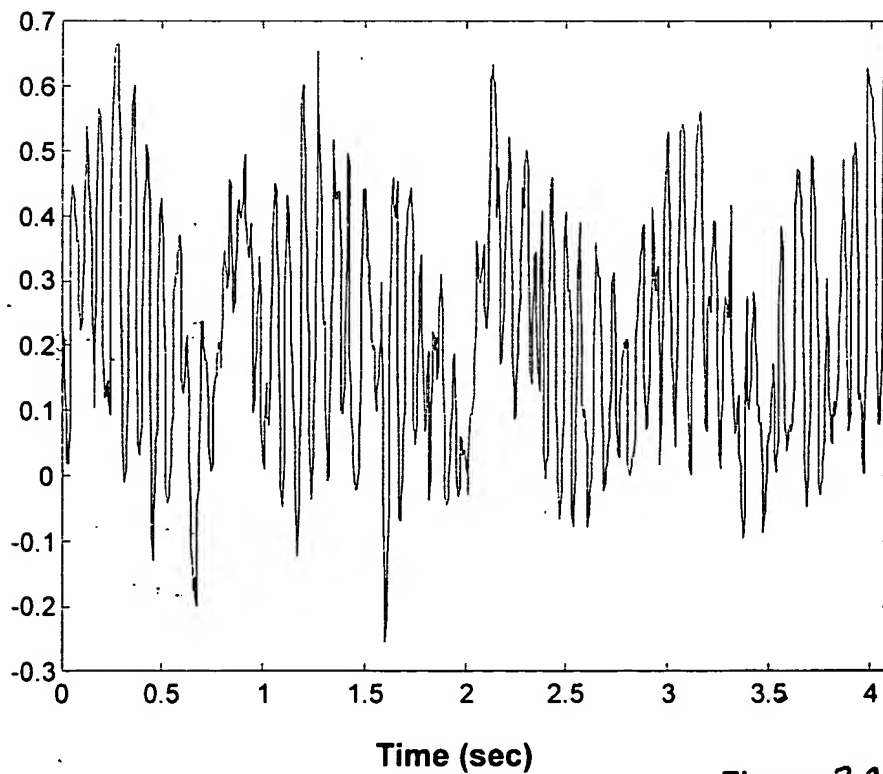


Figure 2.8

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Discrete FT of Strain Gauge Signal for Bearing In Early Failure

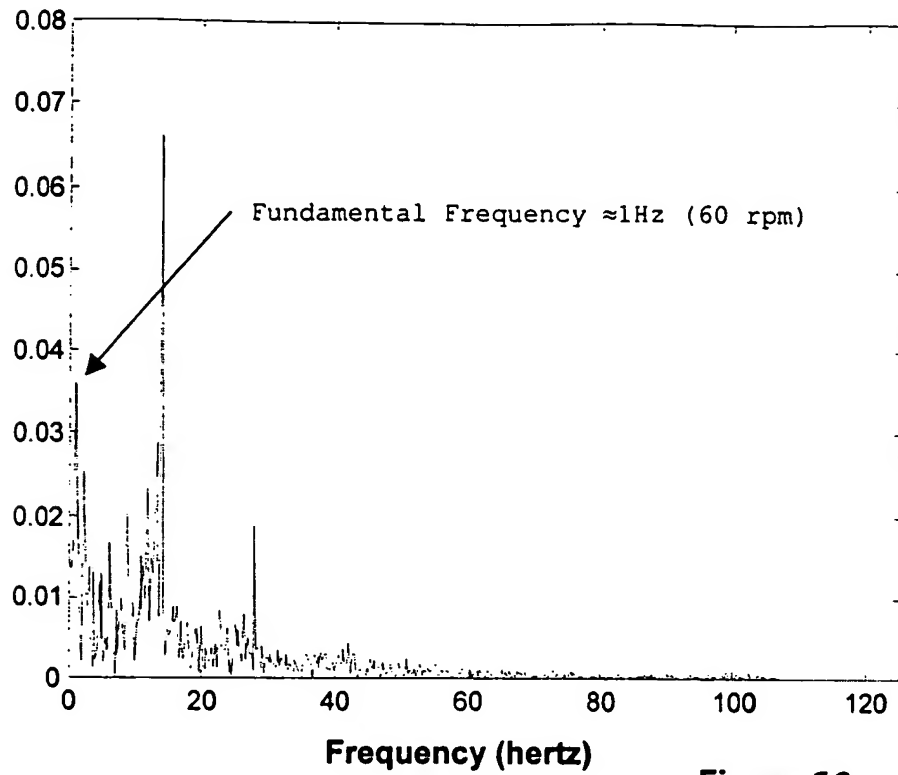


Figure 29

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Mean Strain Analysis for Bearing in Early Failure

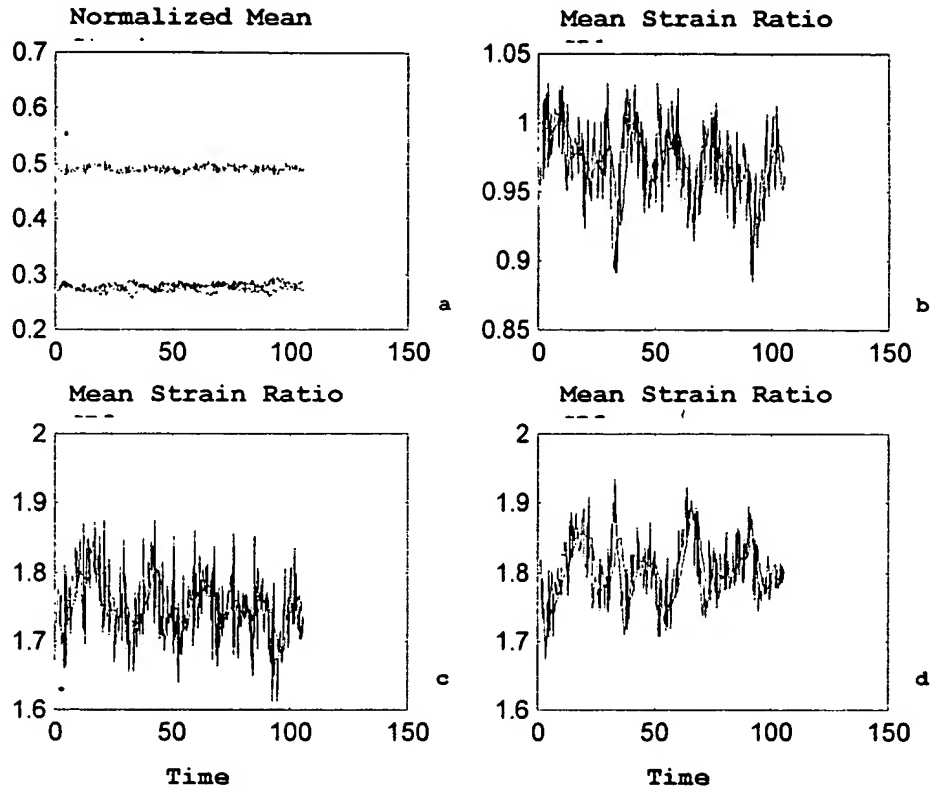


Figure 30.

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Mean Strain Analysis for Shifting Load Condition

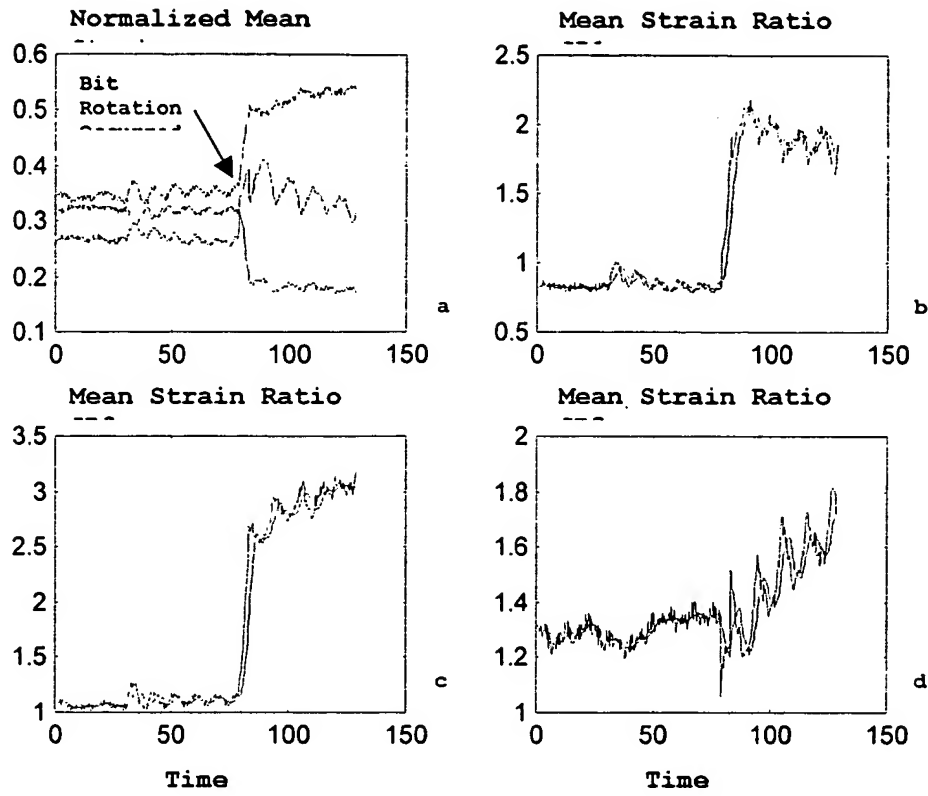


Figure 31.

10035370-102601

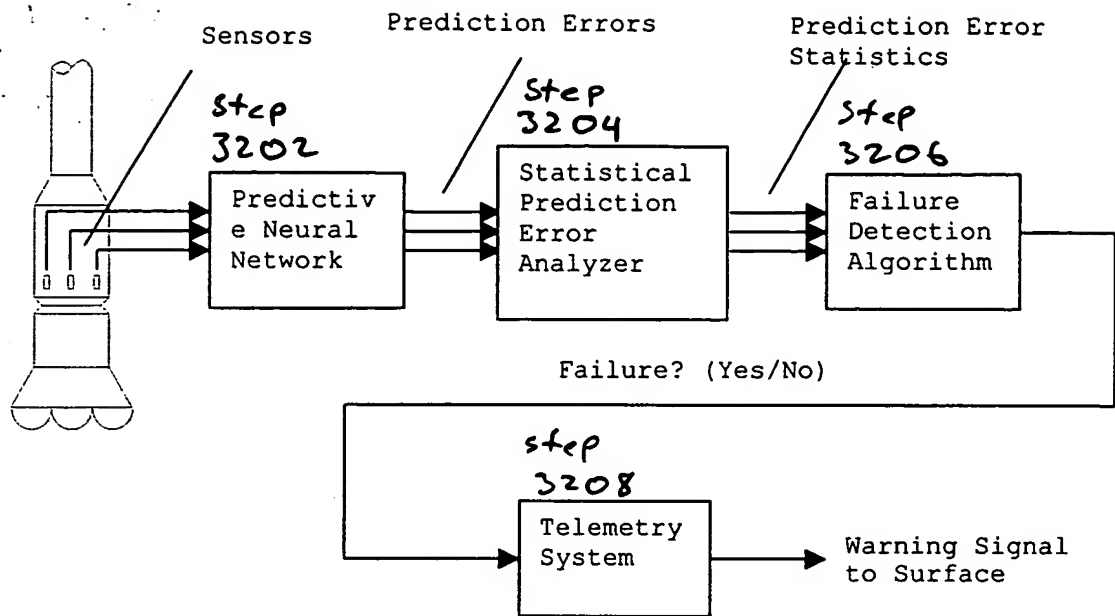


Figure 32 Schematic of ANNPA Bearing Failure Detection Scheme

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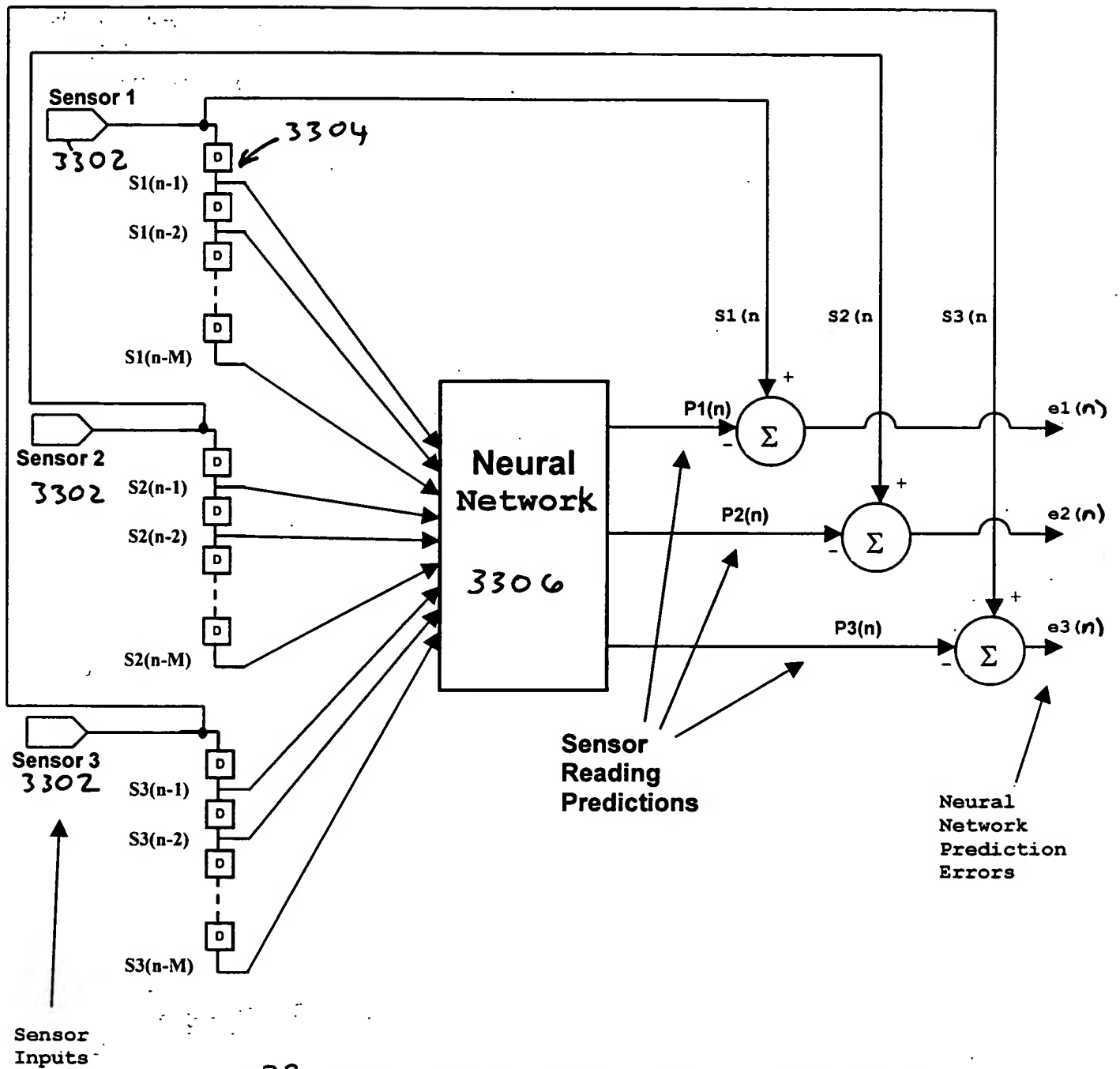


Figure 33 Adaptive Neural Network Predictor (ANNPA Method)

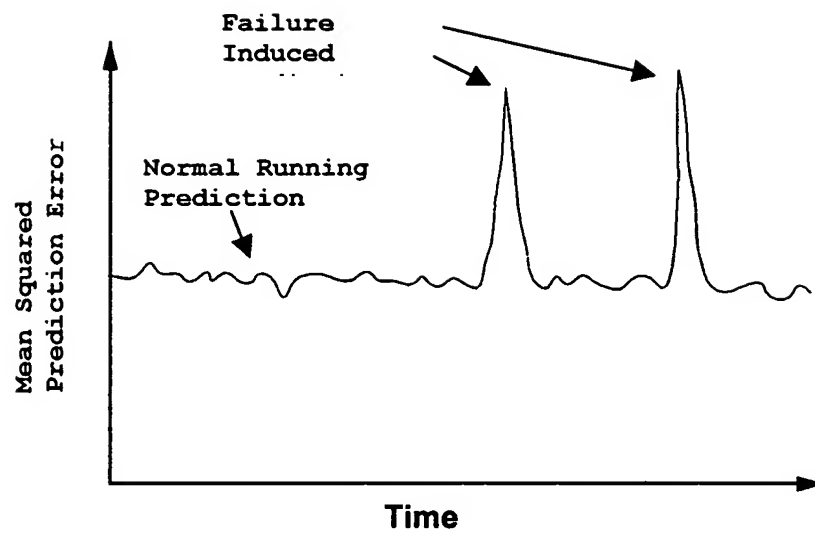


Figure 34 Failure Indications (ANNPA Method)

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Acceleration (No Bearing Damage)

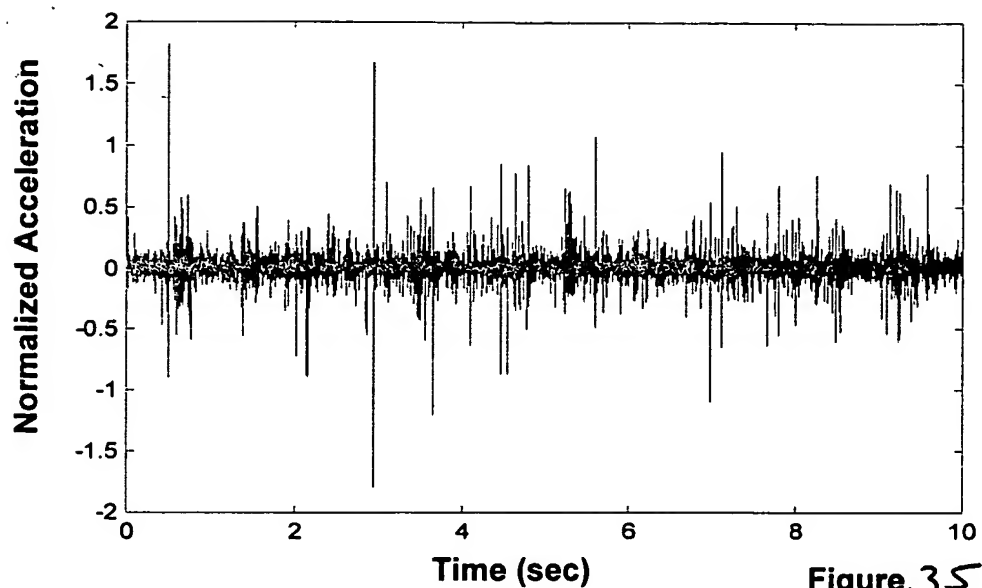


Figure 35

Acceleration Prediction Error (No Bearing Damage)

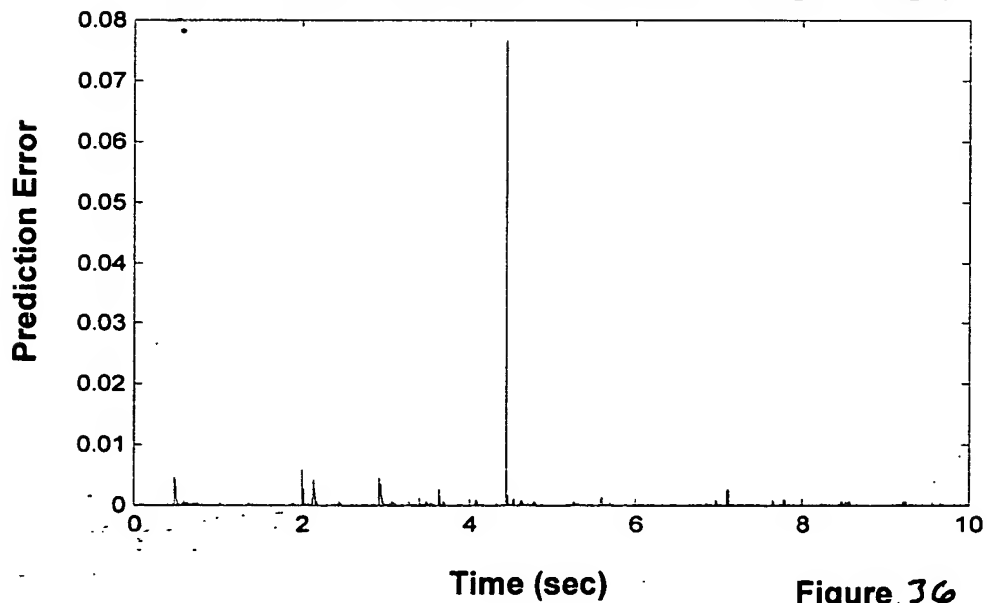


Figure 36

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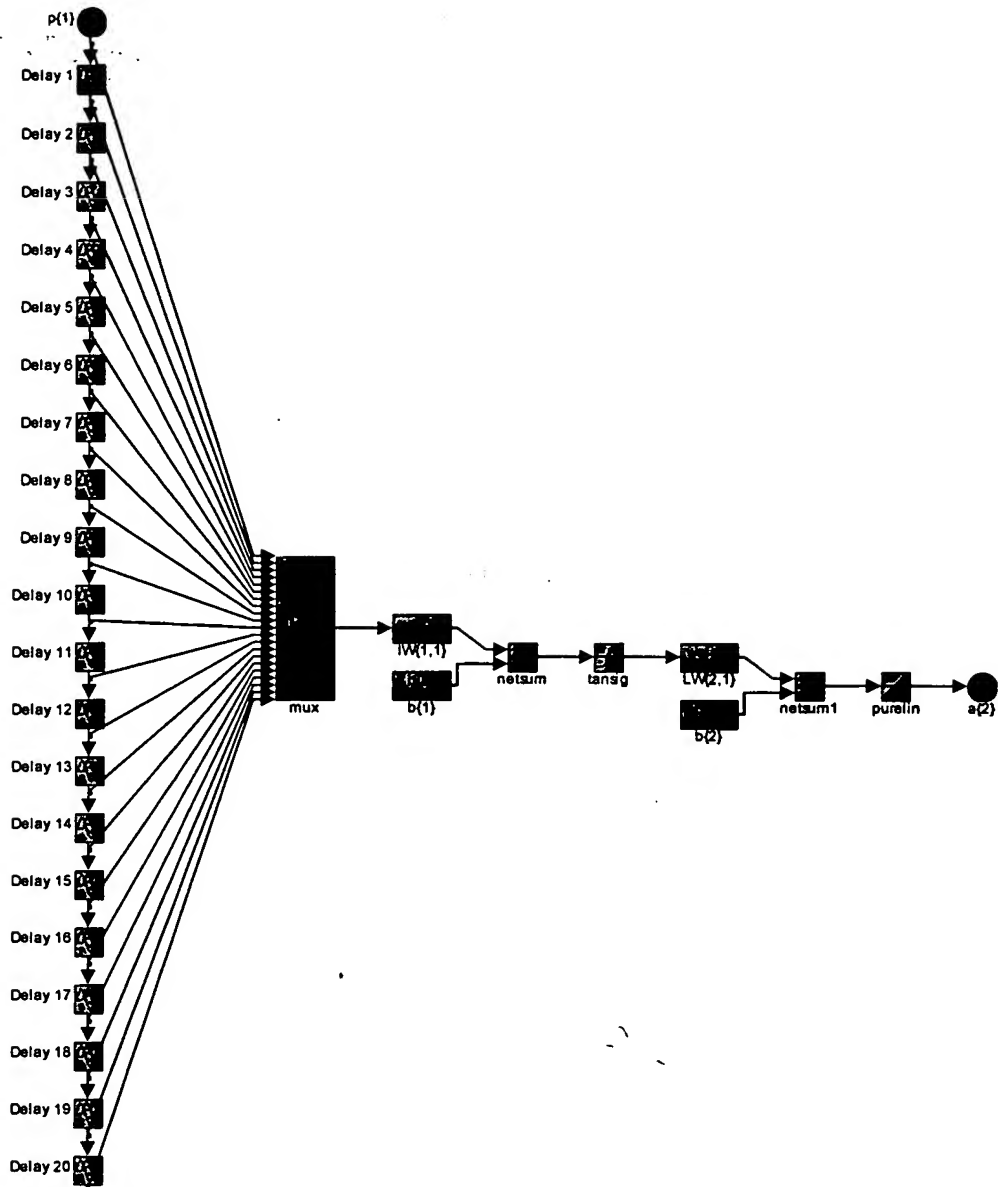


Figure 37

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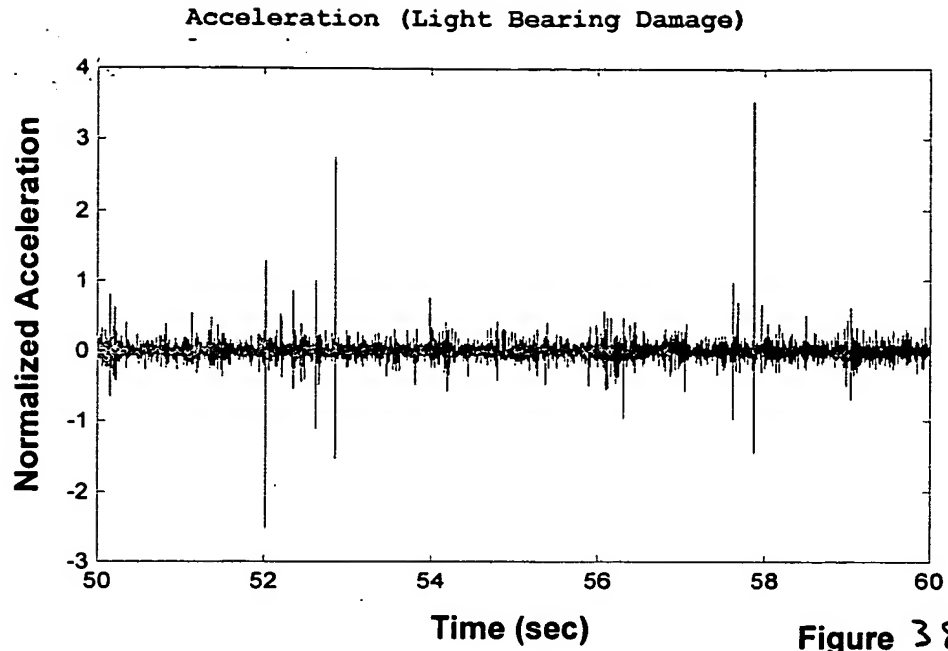


Figure 38

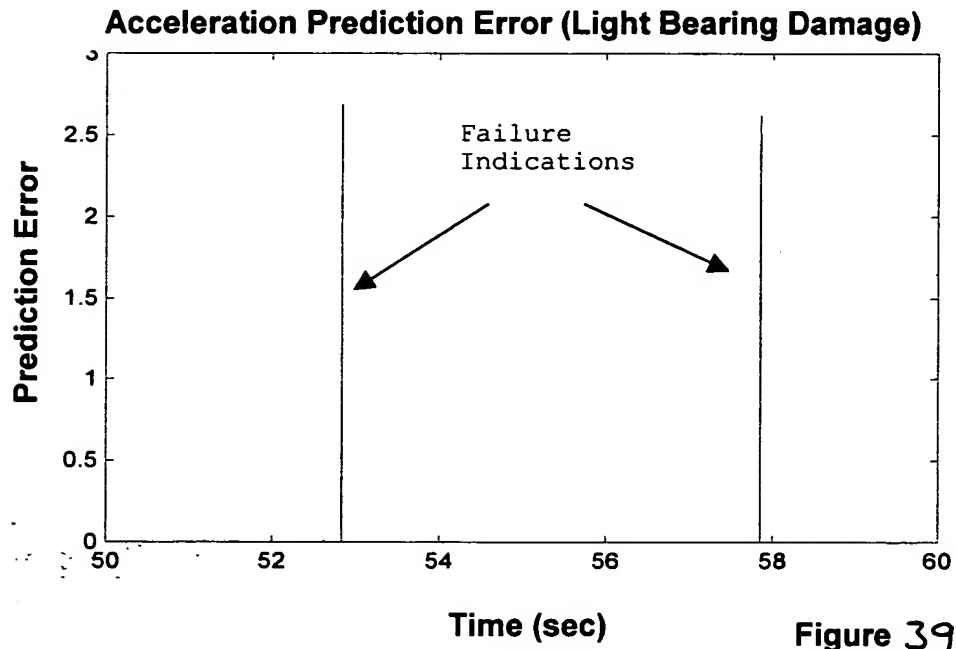


Figure 39

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Acceleration (Moderate Bearing Damage)

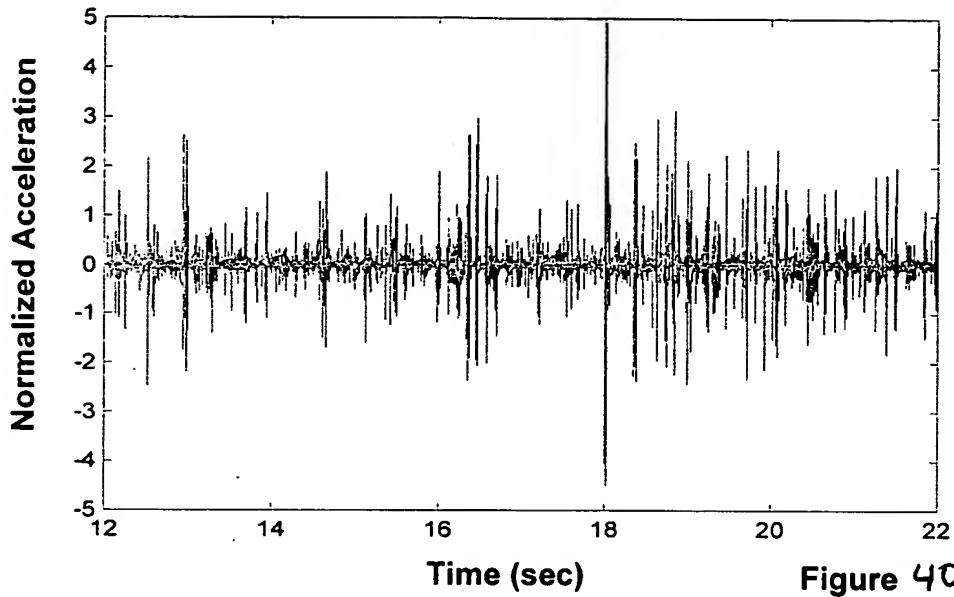


Figure 40

Acceleration Prediction Error (Moderate Bearing Damage)

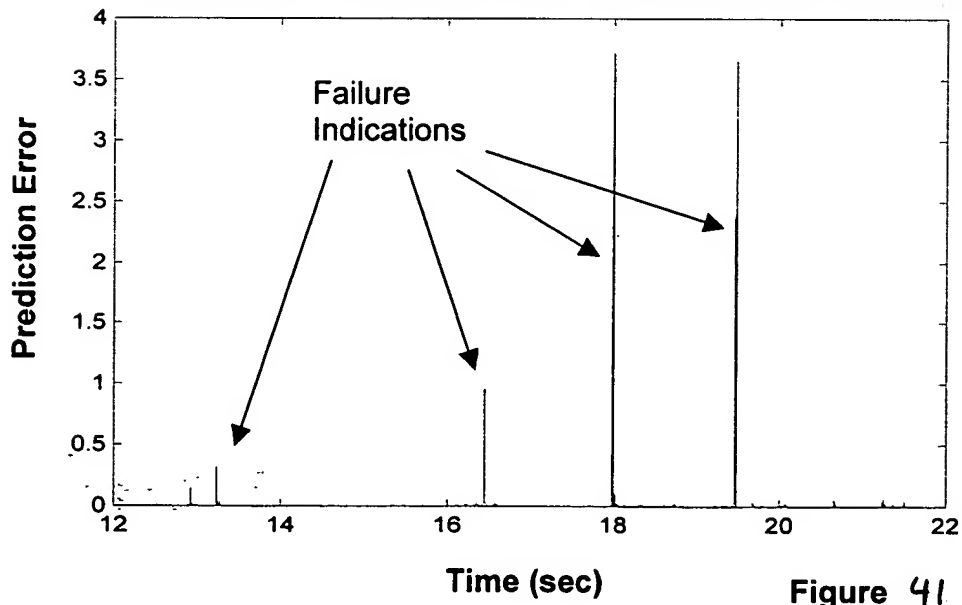


Figure 41

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Acceleration (Heavy Bearing Damage)

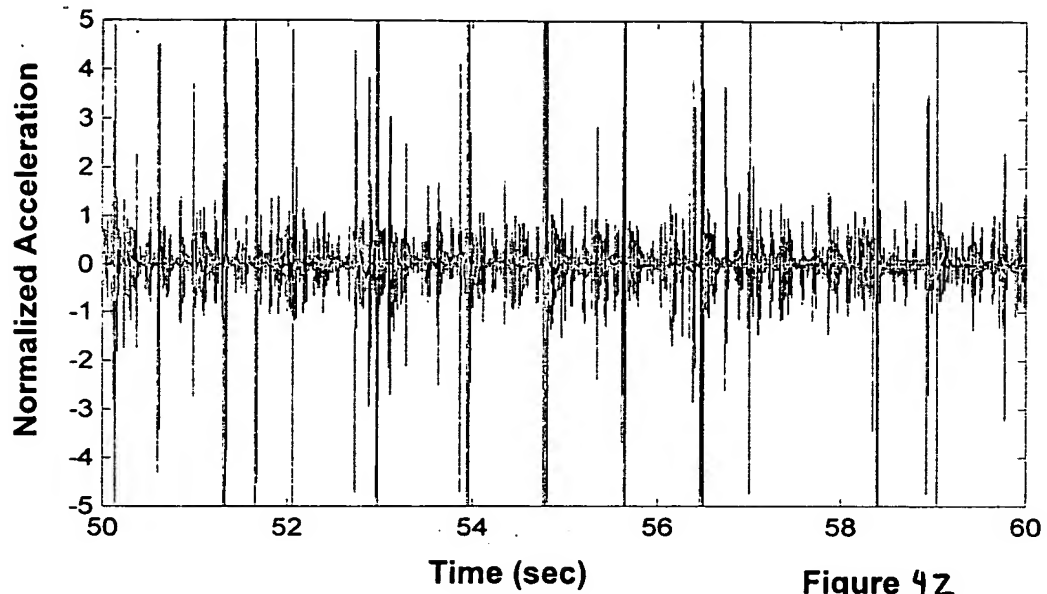


Figure 42

Acceleration Prediction Error (Heavy Bearing Damage)

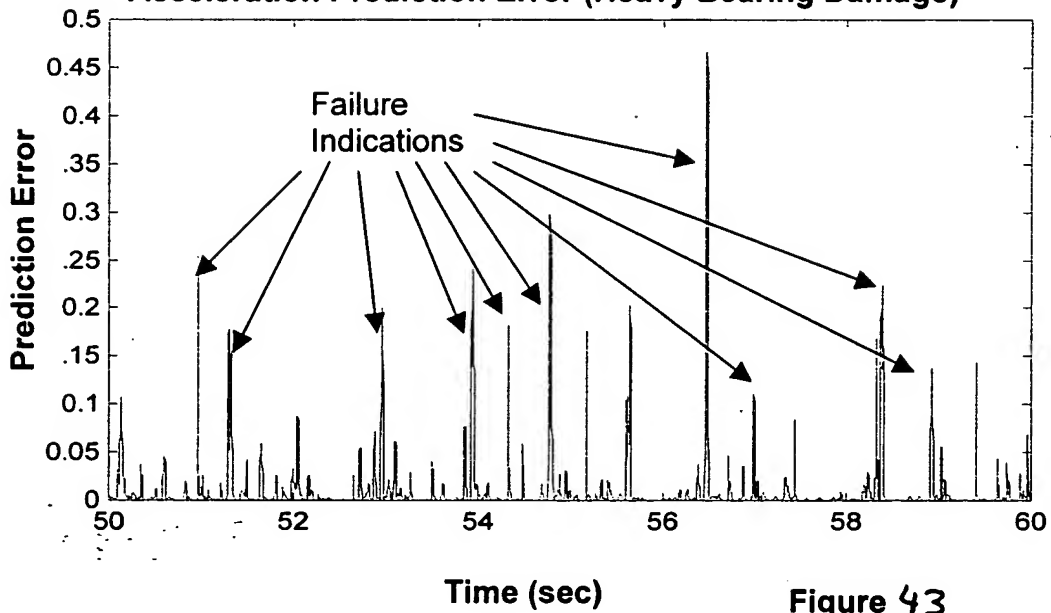


Figure 43

10035350-102601

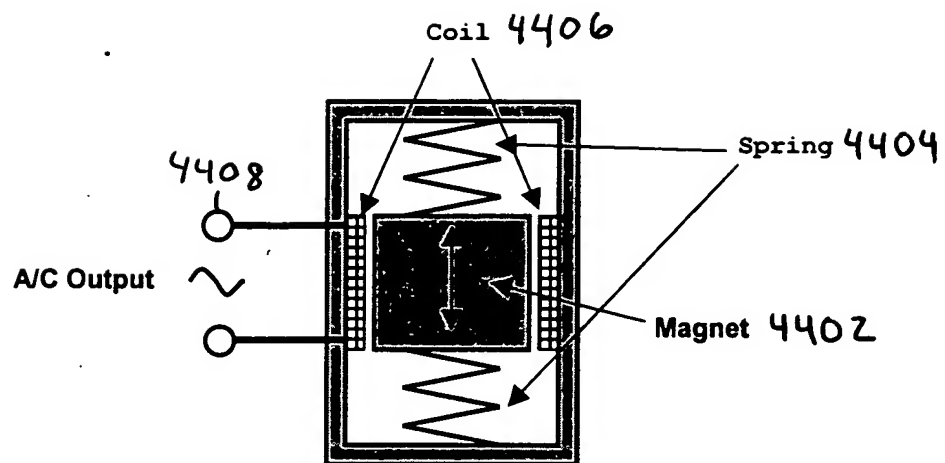


Figure 44 Diagram of Voice Coil Power Generator

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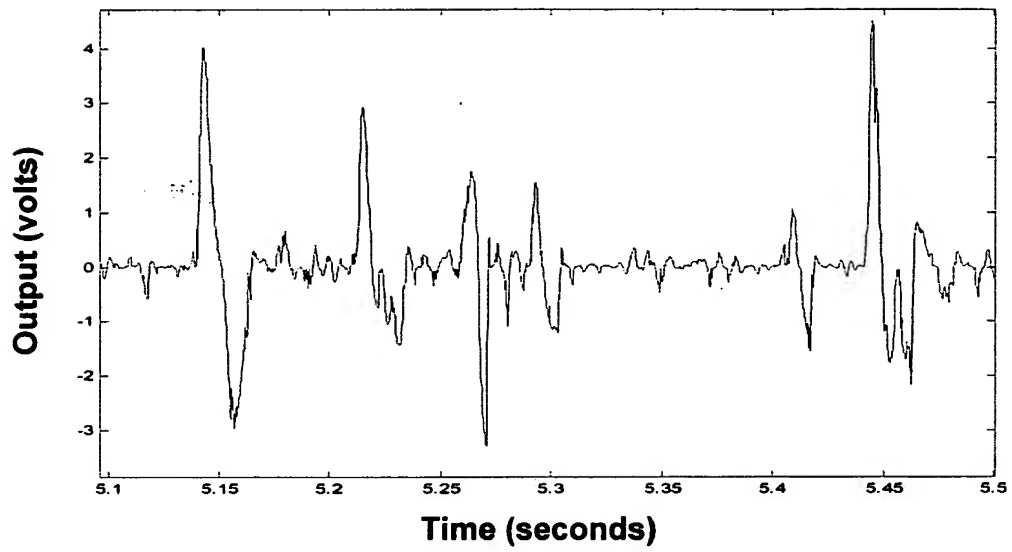


Figure 45 Scaled-Down Prototype Power Generator Output (1000 Ω Load)

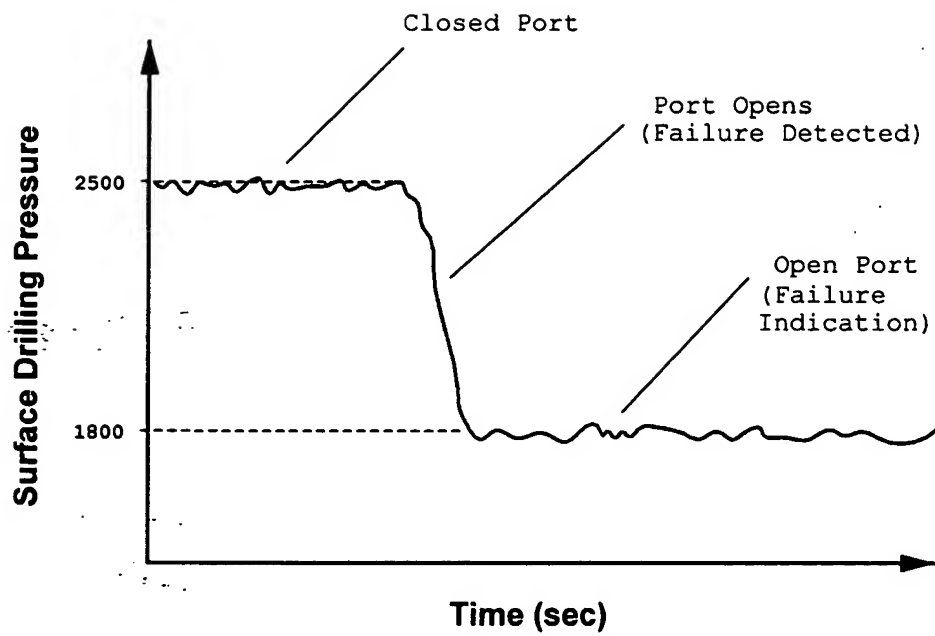


Figure 46 Open Port Failure Indication

10035350-102601

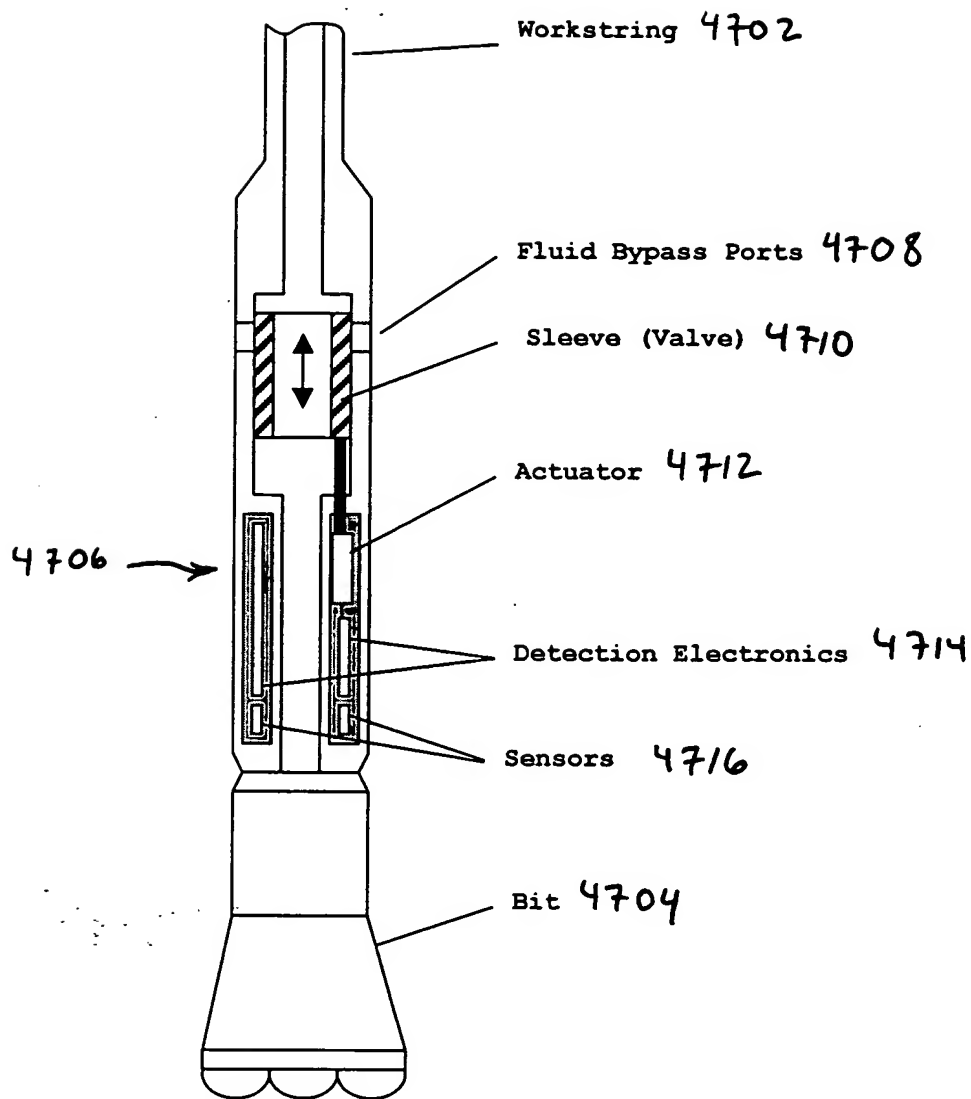


Figure 47 Downhole Tool Schematic

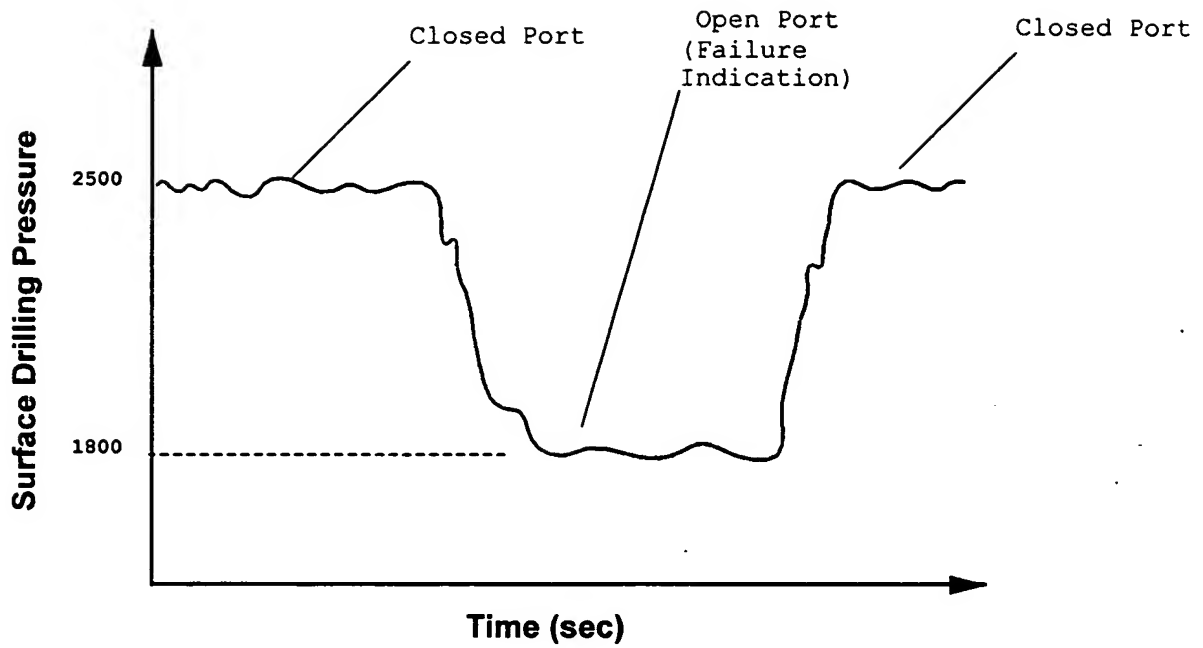


Figure 48 Open-Close Signaling Operation

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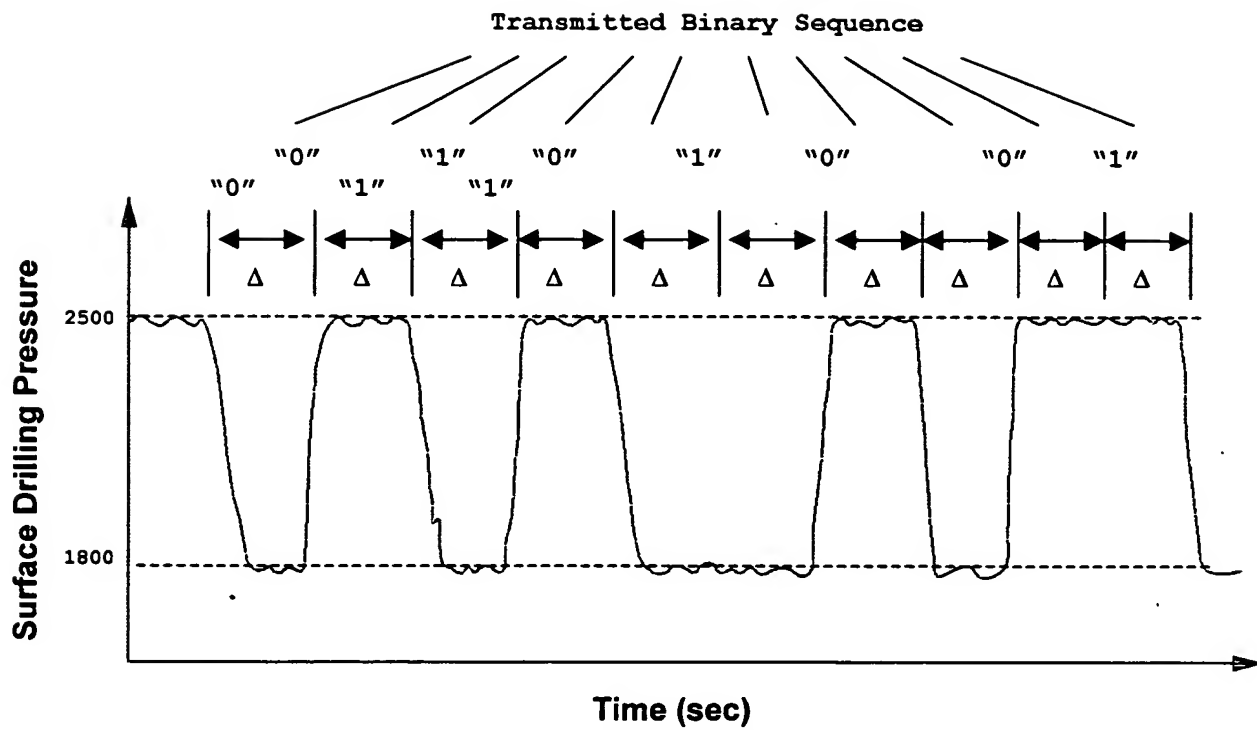


Figure 49 Binary Data Transmission Using Static Pump Pressure Levels

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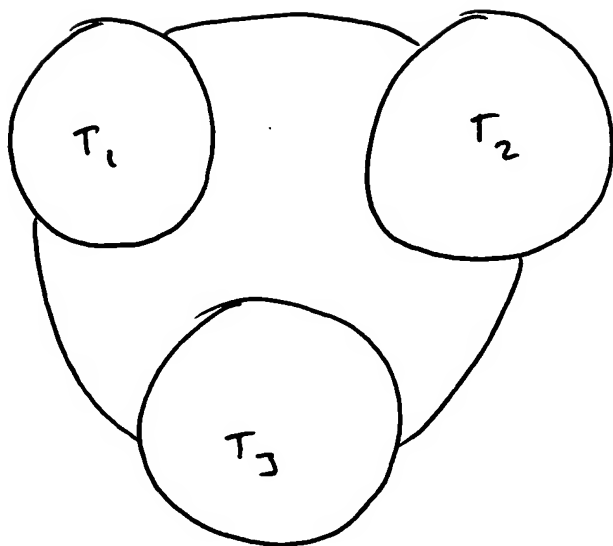


Figure 50

10035350-102601

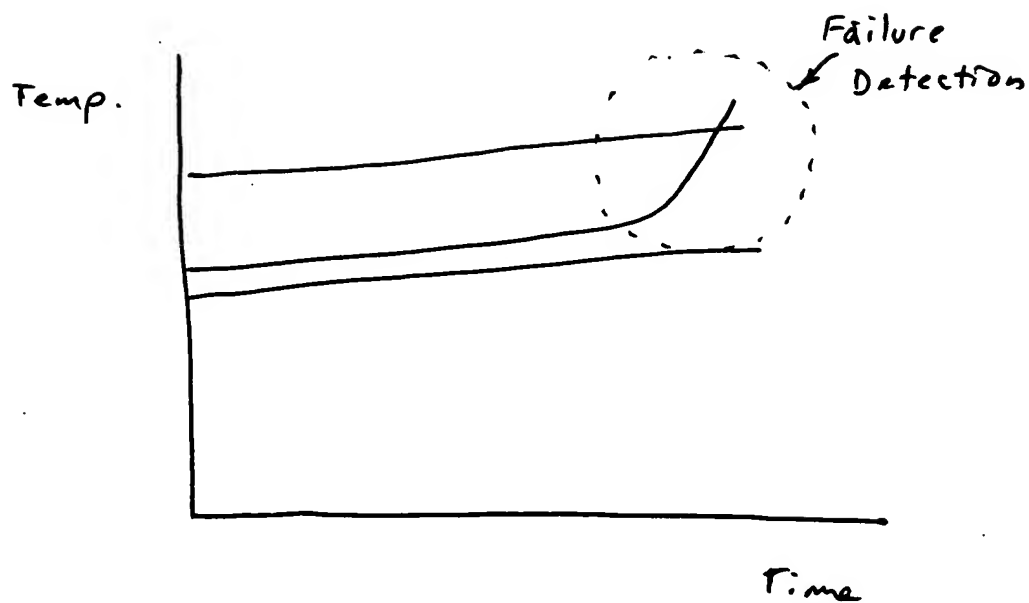


Figure 51

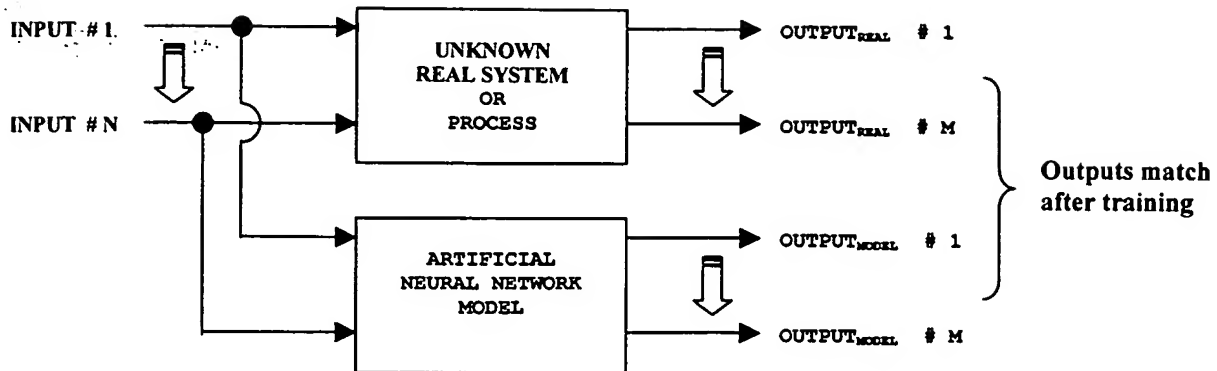


Figure 52 Neural Network Modeling
Real System

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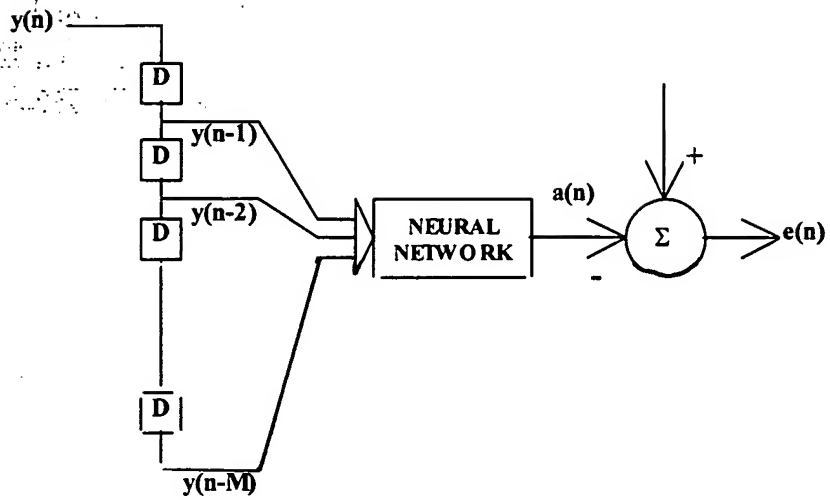


Figure 53

1003510-102601

10035350-102601

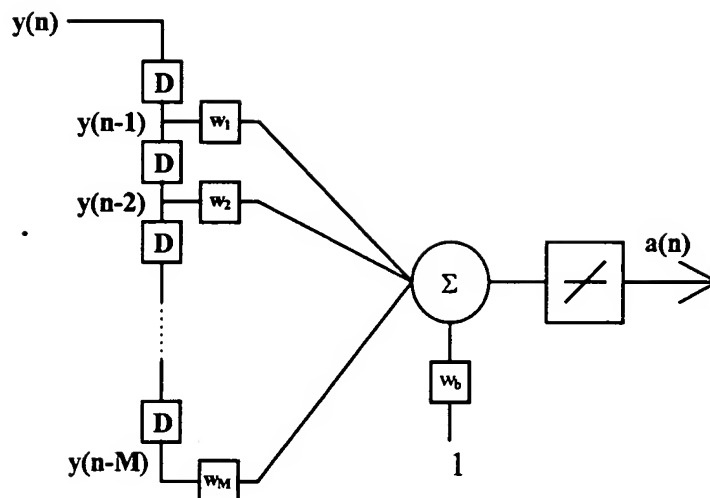


Figure 54 Basic Linear Network

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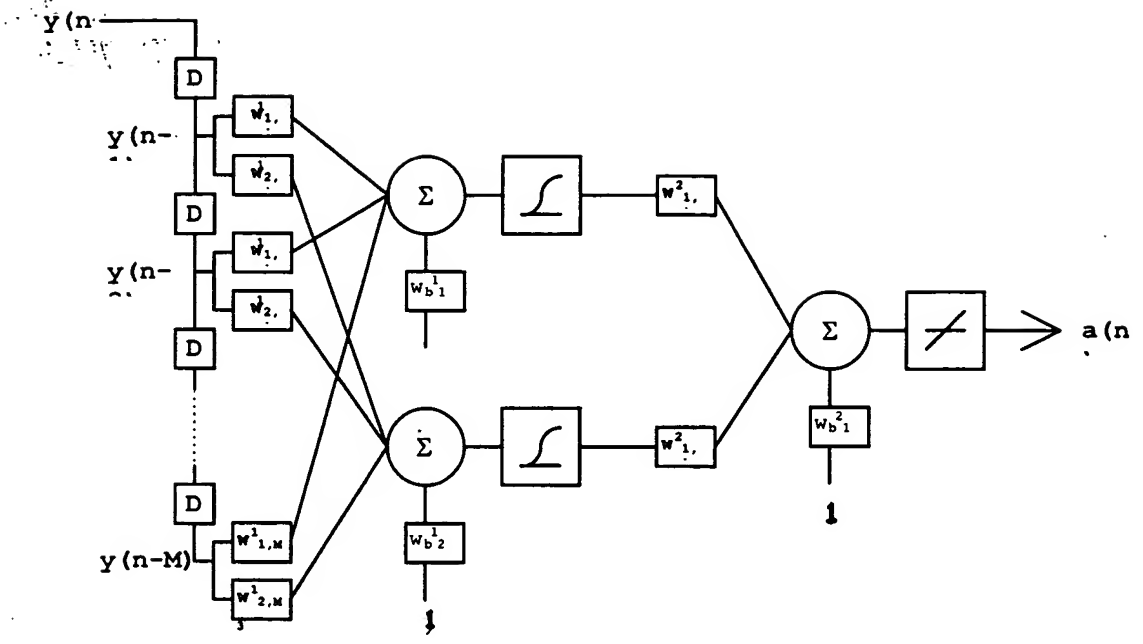


Figure 55

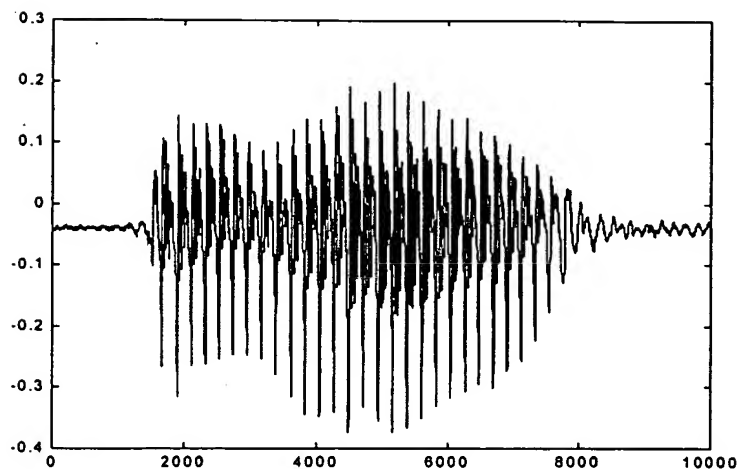
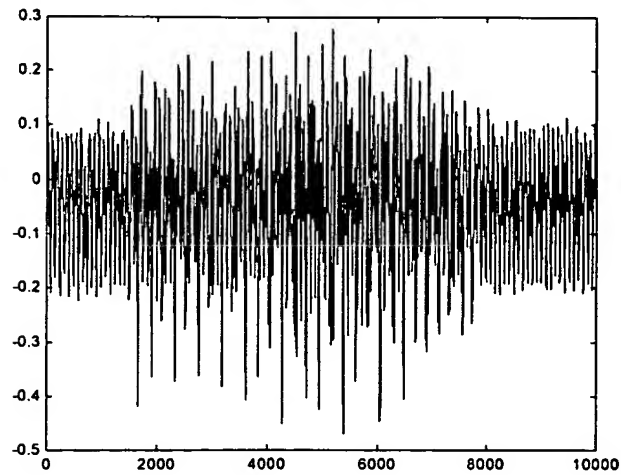
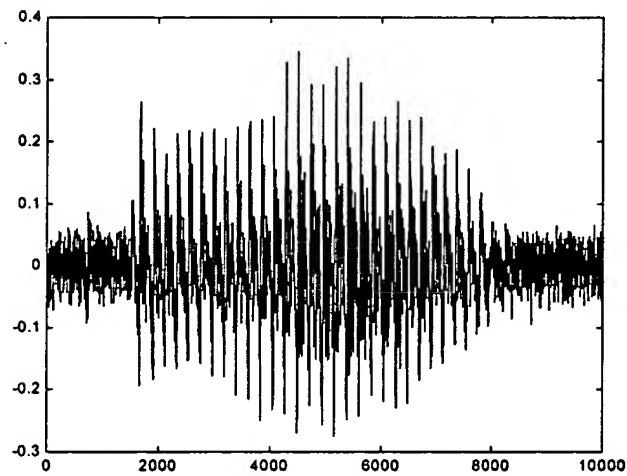


Figure 56

10035350-102601



Corrupt Signal S/N Ratio = .95

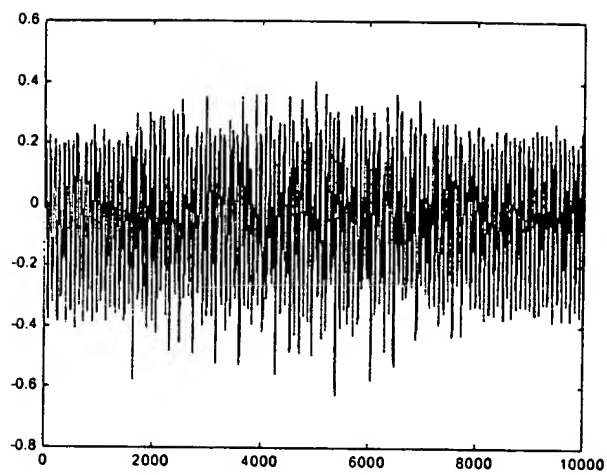


Filtered Signal S/N Ratio = 2.35

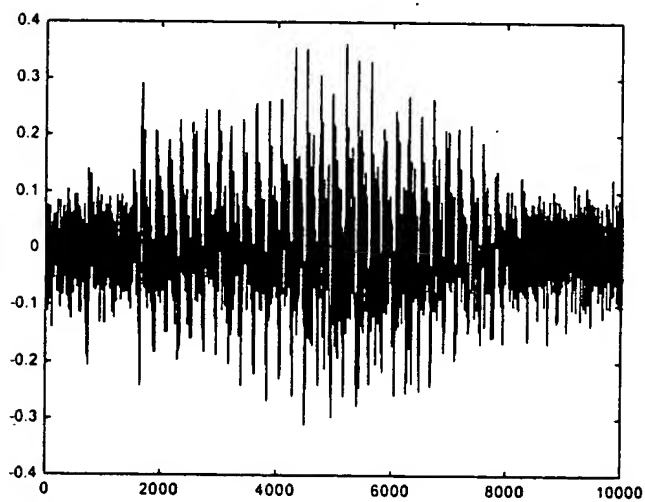
Figure 57

10035350-102601

1003550-10601



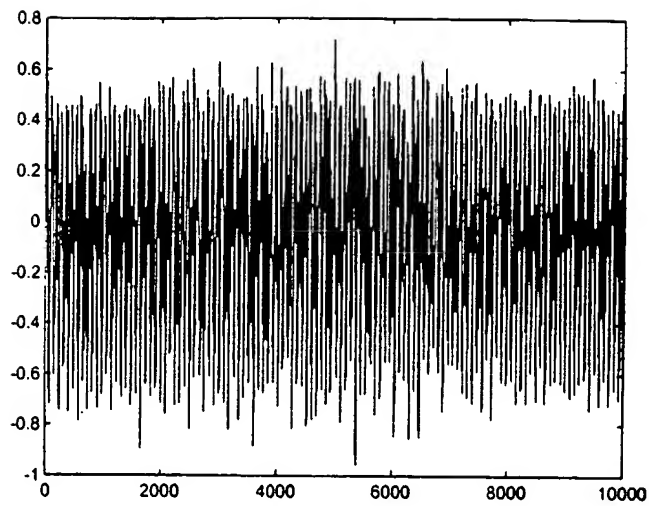
Corrupt Signal S/N Ratio = .24



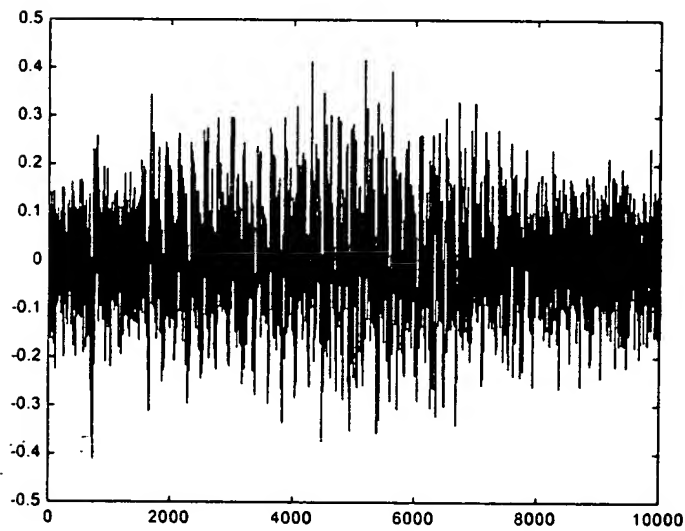
Filtered Signal S/N Ratio = 1.68

Figure 58

10035350-102601



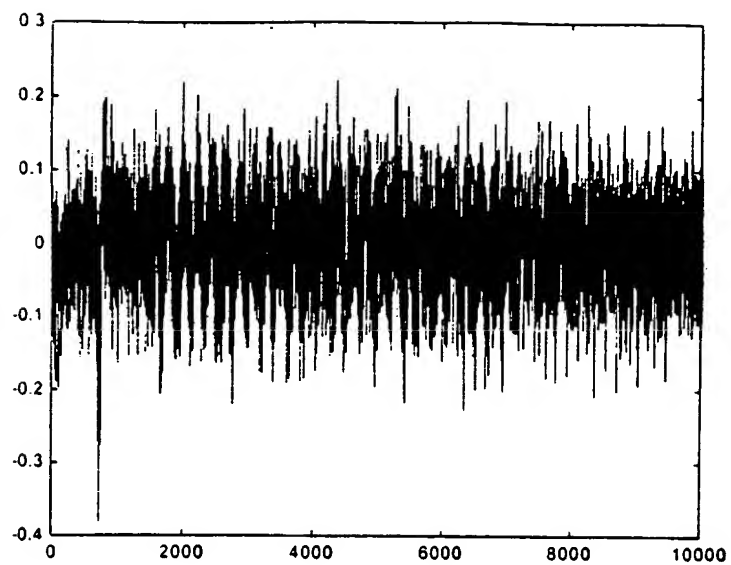
Corrupt Signal S/N Ratio = .06



Filtered Signal S/N Ratio = .89

Figure 59

10035350-102601



Linear filter results. $S/N = .7457$

Figure 60